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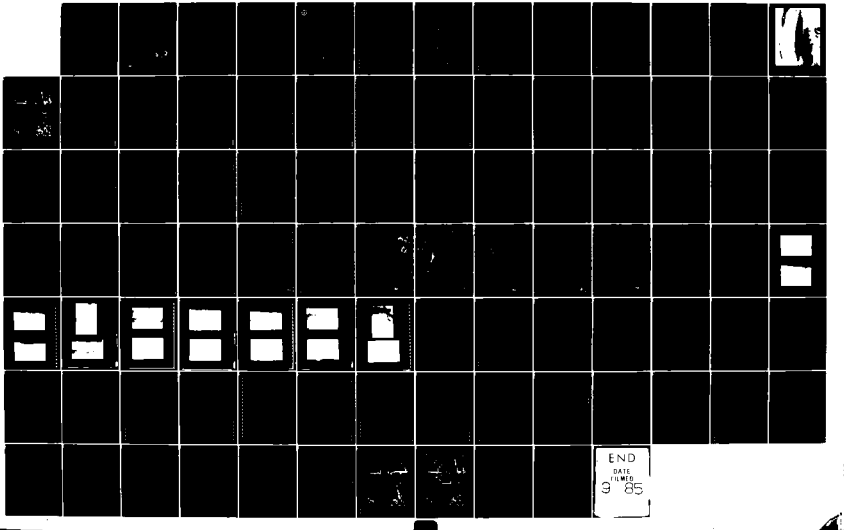

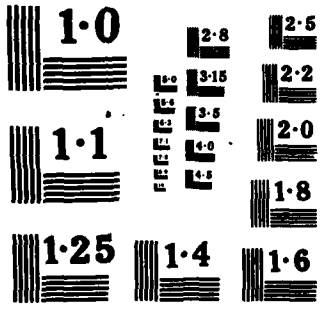
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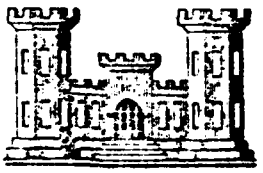
AD-A157 630

CONNECTICUT RIVER BASIN
CHELSEA, VT

KEYSER DAM
VT 00097

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



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Cover program reads: Phase I Inspection Report, National Dam Inspection Program; however, the official title of the program is: National Program for Inspection of Non-Federal Dams; use cover date for date of report.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

DAMS, INSPECTION, DAM SAFETY,

Connecticut River Basin
Chelsea, VT.
Bicknell Brook

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The dam is a 225 ft. long, 44 ft. high homogeneous earth embankment with an upstream slope of 3H:1V and a downstream slope of 2H:1V. It is intermediate in size with a high hazard potential. The dam is judged to be in fair condition. The low level outlet should be made operable and a trash rack should be installed in the drop outlet structure.

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REPLY TO
ATTENTION OF:

NEDED

DEC 31 1980

Honorable Richard A. Snelling
Governor of the State of Vermont
State Capitol
Montpelier, Vermont 05602

Dear Governor Snelling:

Inclosed is a copy of the Keyser Dam (VT-00097) Phase I Inspection Report, which was prepared under the National Program for Inspection of Non-Federal Dams. This report is presented for your use and is based upon a visual inspection, a review of the past performance and a brief hydrological study of the dam. A brief assessment is included at the beginning of the report. I have approved the report and support the findings and recommendations described in Section 7 and ask that you keep me informed of the actions taken to implement them. This follow-up action is a vitally important part of this program.

A copy of this report has been forwarded to the Department of Water Resources, the cooperating agency for the State of Vermont. In addition, a copy of the report has also been furnished the owner, F. Ray Keyser, Jr., Chelsea, Vermont 05038.

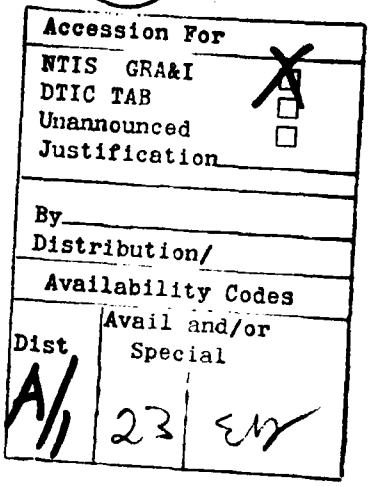
Copies of this report will be made available to the public, upon request, by this office under the Freedom of Information Act. In the case of this report the release date will be thirty days from the date of this letter.

I wish to take this opportunity to thank you and the Department of Water Resources for your cooperation in carrying out this program.

Sincerely,

WILLIAM E. HODGSON, JR.
Colonel, Corps of Engineers
Acting Division Engineer

Incl
As stated



NATIONAL DAM INSPECTION PROGRAM

PHASE I - INSPECTION REPORT

BRIEF ASSESSMENT

Identification No.:	VT00097
Name of Dam:	Keyser Dam
Town:	Chelsea
County and State:	Orange, Vermont
Stream:	Bicknell Brook
Date of Inspection:	October 30, 1979

Keyser Dam is a 225-foot long, 44 foot high homogeneous earth embankment with an upstream slope of 3H:1V and a downstream slope of 2H:1V. A 200-foot long by 18-foot high dike with the same slopes as the dam was constructed in a saddle to the right of the knoll that forms the right abutment of the dam. The 75-foot wide emergency spillway is a cut in the right abutment of the dike. The normal pool level is controlled by an ungated drop-inlet structure that feeds a 24-inch diameter conduit which passes through the dam.

In accordance with Corps of Engineers Guidelines for the Intermediate size and High hazard classification of the dam, the test flood will be the Probable Maximum Flood (PMF). Peak outflow due to the PMF is 2075 cfs, at which time the dam would be overtopped by 0.8 feet. With a water level at the crest of the dam, the capacity of the spillways is 942 cfs, which is 45% of the routed test flood outflow.

Based upon the visual inspection and its past performance, the dam is judged to be in fair condition. It is recommended that the following items be investigated and repairs implemented as necessary: 1) the potential for overtopping due to inadequate spillway capacity; 2) the erodability of the emergency spillway; 3) the suitability of the toe drainage system for the dam and 4) the potential for seepage along the water supply pipe that passes through the dam. In addition, the low-level outlet should be made operable and a trash rack should be installed on the drop outlet structure.

The recommendations and remedial measures are described in Section 7 and should be addressed within one year of the receipt of this Phase I Inspection Report by the owner.

Very truly yours,

DuBois & King, Inc.

John J. Bilotta, P.E.
Project Manager

JJB/chj

This Phase I Inspection Report on Keyser Dam has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgment and practice, and is hereby submitted for approval.

ARAMAST MAHTESIAN, MEMBER
Geotechnical Engineering Branch
Engineering Division

CARNEY M. TERZIAN, MEMBER
Design Branch
Engineering Division

RICHARD DIBUONO, CHAIRMAN
Water Control Branch
Engineering Division

APPROVAL RECOMMENDED:

JOE B. FRYAR
Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably-possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that

a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

The Phase I investigation does not include an assessment of the need for fences, gates, no-trespassing signs, repairs to existing fences and railings and other items which may be needed to minimize trespass and provide greater security for the facility and safety to the public. An evaluation of the project for compliance with OSHA rules and regulations is also excluded.

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OVERVIEW PHOTOGRAPH OF KEYSER DAM

resulting surcharge storage of 29 acre-feet. The routed test flood outflow would be 2075 cfs, which is 3% less than the inflow. The spillways can pass 942 cfs at the top of the dam (elevation 107.9 NGVD) or 45 percent of the test flood outflow. The ½ PMF flood of 1075 cfs would have an outflow of 1010 cfs, a reduction of 6 percent, and would overtop the crest of the dam by 0.1 feet (elevation 108.0 NGVD).

5.5 Dam Failure Analysis

Using the Corp's April 1978 "Rule of Thumb Guidance for Estimating Downstream Dam Failure Hydrographs," a dam failure analysis was performed for Keyser Dam. The dam breach analysis was performed assuming the water level at the crest of the dam (el. 107.9) and the emergency spillway would be discharging 942 cfs. The breach height (upstream toe to water surface) would be 21.9 feet. The guidelines indicate that failure analysis should be based on sudden failure of 40% of the dam length. Such a failure would imply that the reservoir must empty in less than two minutes, which is unreasonably fast. Hence, a failure width of 30% (67.5 feet) of dam width was used in the Saint-Venant equation to compute a breach outflow of 11,600 cfs over and above the 942 cfs being discharged by the emergency spillway. This breach flow would empty the reservoir in approximately 6 minutes.

The breach would produce a 6.2-foot flood wave and the resultants stage of Bicknell Brook would be 10.7 feet above streambed at the initial impact area. Downstream 5000 feet at Bicknell Brook's confluence with the White River, the flood wave would be 5.5 feet high with a stage of 11.0 feet above streambed. There are two houses which would be flooded in that reach with flood levels up to 3 feet above the first floor level. It is likely that more than a few lives may be lost if the dam is breached and therefore the dam is classified as High hazard.

SECTION 5

EVALUATION OF HYDRAULIC/HYDROLOGIC FEATURES

5.1 General

Keyser Dam has no moving parts or mechanical controls. Keyser Dam has an earth spillway and a 24-inch diameter pipe for its outlets. The earth spillway serves as the emergency spillway which has its crest at 105.4 feet. The field measured weir length of 75 feet was used in the computations, and because of the nature of the spillway design a weir coefficient of 2.48 was used to compute discharges. The 24-inch pipe has a concrete drop inlet entrance with a circumferencial length of 15 feet. It acts as a control weir at elevation 104.0. The invert of the pipe is at elevation 102.0. The weir provides flow control below elevation 105.1. Above that level, pipe flow controls with a limited capacity, restricting flow to approximately 52 cfs. An anti-vortex plate has been installed to prevent air from being drawn into the pipe, which would lessen its efficiency.

With the pool level at the crest of the emergency spillway, the pipe will pass approximately 51 cfs, and at the top of the dam it will pass 52 cfs. At the dam's crest, the emergency spillway can pass approximately 890 cfs making a total project discharge of 942 cfs.

The watershed of Keyser Dam is generally steep mountainous terrain with little man-made development. The reservoir area is approximately 1% of the drainage area, hence, litle flood attenuation can be anticipated.

5.2 Design

Design data for Keyser Dam was provided by the Soil Conservation Service, Burlington, Vermont office. Their design was reviewed and found to be based upon sound engineering judgment and practice.

5.3 Experience Data

There are no records of overtopping or peak flows at Keyser Dam.

5.4 Test Flood Analysis

The height of this structure puts it in the Intermediate class, its height being 44 feet. The hazard classification was determined to be High because failure of Keyser Dam is likely to endanger one to two dwellings and the occupants. The envelope curve for Mountainous Areas provided by the Corps of Engineers was used to obtain a unit discharge in cfs per square miles. The unit discharge per square mile was then multiplied by the actual drainage area, .84 square miles to get the PMF inflow of 2150 cfs. The test flood was routed through the reservoir assuming the water surface to be initially at elevation 104.0 (normal pool level). Calculations indicate that the structure will be overtopped by 0.8 feet (elevation 108.7 NGVD) with a

SECTION 4

OPERATIONAL AND MAINTENANCE PROCEDURES

4.1 Operational Procedures

a. General. There are no operating parts on Keyser Dam. Normal inflow and outflow are automatically controlled by weirs and pipes. Once the inflow increases the lake level above elevation 104.0, the 15-foot weir surrounding the pipe spillway restricts the flows. The capacity of the pipe spillway is 52 cfs. Above a lake level of 105.4, discharge is controlled by the 75-foot wide emergency spillway.

b. Warning System. There is no system either to warn of an impending flood or to warn of possible overtopping.

4.2 Maintenance Procedures

a. General. There is no established program for maintaining the dam. Maintenance is performed on an as needed basis. The owner reportedly performs a visual inspection each spring and fall. No written records of past inspections were available. Growth on the downstream face has been cut but some substantial brush was present on the day of the inspection.

b. Operating Facilities. Maintenance cannot be performed on the upstream side of the dam, dike or principal spillway without bailing in some way. Since the pond drain has reportedly been crushed, a pump, or other means,would be required to lower the water level. Even with the pond drain operating, pumping would still be needed to effect repairs or maintenance at the upstream toe of the dam, which is about 10 feet lower in elevation than the pond drain.

4.3 Evaluation

The absence of a working pond drain prevents maintanance of the upstream face. The growth on the downstream face is not cut frequently enough to prevent the growth of bushes and small trees.

Current procedures are considered to be inadequate to insure that all problems enountered can be remedied within a reasonable period of time. The owner should establish written procedures for operating and maintaining the structure.

d. Presently, there is no low-level outlet by which the dam can be drained in case of an emergency. The owner stated that the upstream end of the low-level outlet was damaged during construction and was abandoned as a result. The low-level outlet should be located and repaired.

e. The original design indicates that the emergency spillway would discharge into an adjacent valley thus safeguarding the toe of both the dike and the main dam. Actual field conditions show that the spillway does in fact return all flows to the valley immediately downstream of the dam. Consequently, spillway discharges may cause erosion of the downstream toe of the dam.

f. The water supply pipe which passes through the berm of the main dam represents a possible seepage path which could lead to erosion of the dam.

g. The toe drain pipes fail to intercept all of the flow in the drains since they have been placed too high to intercept all of the drainage. The additional 4-inch toe drain pipe installed by the owner in 1969 does not relieve all the wetness from the toe and may require a more detailed study.

(with little or no clay). Hence, it would appear to be erodable if any significant flow were to occur.

Principal Spillway - The principal spillway consists of a 24-inch diameter corrugated metal pipe that originates within a 30-inch deep drop inlet structure (Photo 13) which is controlled by a concrete weir with a circumferencial length of 15 feet (Photo 14). The concrete weir at the principal spillway intake structure is in good condition, without cracks or significant efflorescence. The painted antivortex steel plate has begun rusting (Photo 13).

There are no functioning trash racks on the principal spillway. The existing trash rack is wooden and is ineffective. Hence, debris could enter and plug the 24-inch diameter conduit that drains through the Main Dam.

Outlet Conduit. The outlet for the pond is a hooded, 24-inch C.M.P. with an antivortex plate (Photo 15). The outlet conduit was in apparently good condition with no signs of deterioration. The stream channel downstream of the outfall (Photo 16) was in fair condition with rocks, boulders and granite slabs strewn in the channel. Although they did not appear to significantly obstruct the channel, the impact basin areas was poorly defined and did not appear as shown on the plans.

d. Reservoir Area. A small recreation pool extends several hundred yards upstream of the dam and the dike (Photo 6). There is no evidence of overhanging trees.

e. Downstream Channel. The downstream channel is steep with a rock floor. There is a considerable amount of forest growth up the the edge of the channel on both banks (Photo 16).

3.2 Evaluation

On the basis of the visual inspection, the dam is judged to be in fair condition. The following features if left unattended could result in deterioration of this dam.

a. The channel of the ememrgency spillway is spottily grassed, non-plastic glacial till. The erodability of this till at design flows should be determined so that its stability can be verified.

b. The outlet structure of the principal spillway does not have a functioning trash rack. Debris could enter the outlet conduit and plug it. This deficiency should be corrected since the emergency spillway was not designed to have constant flow.

c. Soil cover over the downstream end of the 24-inch outlet conduit is minimal.

A 1-inch diameter galvanized iron water supply pipe was installed during construction at a level about 15 feet below the crest at Sta 1+75. It is not known whether anti-seep collars were installed. There is some erosion of the grass around the downstream end of the pipe but there was no seepage occuring on the day of inspection.

The earth cover on top of the 24-inch diameter principal spillway conduit is very thin near the downstream toe (Photo 8). Heavy equipment passing over the drain could damage the pipe.

Dike. The dike is the portion of Keyser Dam to the right of the angle point (Photo 9). It was referred to as Structure B-B in the design drawings. The emergency spillway is cut through the right abutment of the dike (Photo 11).

The drawings show two toe drain pipes on the downstream side of the dike. They are 6-inch C.M.P. and their discharge is located at Sta 4+65, near the right abutment, about 20 feet downstream from the toe. A stone wall forms an enclosure into which the toe drains discharge (Photo 10). The drain located at the left in the photo (near the ruler) was discharging clear water at about 2 gpm. The other, about 4 feet to the right (Photo 10), was discharging clear water at about 1 gpm.

Buried beneath the ground, about 10 feet upstream from the toe drain discharge points, according to the owner, there exists the downstream end of an 8-inch diameter C.M.P. which was supposed to be the drawdown pipe, i.e., the low-level outlet for the dam. It was reportedly crushed by heavy equipment during construction. Therefore, it was plugged on the upstream and downstream ends. Since the end cannot be seen, it is not known whether any leakage is occurring now.

Some dampness, but no flow, was evident near the right abutment contact line.

The remarks given above relative to the riprap along the upstream shoreline of the Main Dam apply also to the dike.

A small irregularity about 0.5 feet deep exists in the crest of the dike near Sta 4+00.

c. Appurtenant Structures

Emergency Spillway - The emergency spillway was discovered to be more than twice as wide as shown on the construction plans and within one inch of the plan elevation. The orientation of the spillway appeared to agree with the plans, but the exit channel does not spill into another valley as the plans indicate. Rather, the exit channel spills near the dike abutment and heavy flows may erode the toe of the dam (Photo 1). The emergency spillway is cut into glacial till in the right abutment of the dike (Photo 11). The channel and training dikes are all grass-covered but the grass is spotty (Photo 12). The glacial till is a nonplastic sandy silt

SECTION 3

VISUAL INSPECTION

3.1 Findings

a. General. The field inspection of Keyser Dam was performed on October 30, 1979. The weather was overcast with temperatures near 40°F. The inspection team included personnel from DuBois & King, Inc.; Geotechnical Engineers Inc.; and Knight Consulting Engineers, Inc. A representative of the Vermont Department of Water Resources and the owner accompanied the inspection team. A copy of the inspection checklist as completed during the field inspection is included in Appendix A. At the time of the inspection, the elevation of the water was 104.0, i.e. 3.9 feet below the crest of the dam. This elevation is maintained by a concrete weir and is the permanent recreation pool level.

b. Dam. The dam is a 44-foot high earth embankment with a length of 225 feet and a 14-foot top width. The structure has side slopes of 3 horizontal to one vertical on the upstream face and 2 horizontal to one vertical on the downstream face (Photo 1). Immediately to the right of the dam is a 200-foot long dike with the same top width and side slopes (Photo 2 and 3). The dike is 18 feet high. Flows and water levels are controlled by a principal spillway which consists of a small drop inlet and a 24-inch diameter pipe located at the right abutment of the main dam (Photo 4). Larger flows are controlled by a 75 foot wide emergency spillway located to the right of the dike.

Main Dam. The main dam is to the left of the angle point, which is a natural glacial till knoll that forms its right abutment. The main dam is referred to as Structure A-A in the design drawings.

The discharge outlet from the 6-inch C.M.P. toe drain installed during construction is located at Sta 1+50 at the toe of the dam in the former stream channel (Photo 7, lower pipe). It was running at about 5 gpm and the water was clear.

A second toe drain system was installed after construction, and it is discussed in more detail in Section 6.3. A 4-inch diameter C.M.P. was used for this second system. It discharges at a point vertically above the original drain (Photo 7 upper pipe), and was flowing at less than ¼ gpm of clear water on the day of inspection.

A berm was placed on the downstream side of the dam by the owner about 10-12 years ago (more detail provided in Section 6.3). The toe of this berm from about Sta 1+50 to 2+00 is wet, apparently due to seepage which bypasses the drain that was installed under the berm.

A row of quarry slabs of granite have been placed along the upstream shoreline to act as riprap (Photo 5). They are discontinuous and no filter material is apparent beneath them. These slabs afford some protection against the small waves that may be generated on this pond. However, they also form roofed openings beneath which animals could burrow unseen.

SECTION 2

ENGINEERING DATA

2.1 Design

Design drawings were prepared by the USDA Soil Conservation Service for the owner. A copy of the design notes, construction drawings and specifications, test data on the soils, a geological report, and a geotechnical report, all prepared by the Soil Conservation Service are contained in files of the Vermont Agency of Environmental Conservation, Department of Water Resources. The structure was designed in 1963.

2.2 Construction Data

Construction activities were performed by the owner who acted as General Contractor. There were neither photographs nor descriptive records available to the inspection team.

2.3 Operation

There are no moving parts to Keyser Dam. Operation is automatic. The primary spillway weir regulates flows less than 52 cfs and the emergency spillway discharges outflows greater than 52 cfs. The owner performs a periodic visual inspection, but no written records of past inspections were available.

2.4 Evaluation

a. Availability. Although the available information provided a reasonable and acceptable basis for the analysis of the design of the structural components, additional field data is required to determine the stability of the structural components beyond the original assumptions. The hydrologic data was acceptable and much of the original data was used in the comparison prepared for this analysis.

b. Adequacy. The available data was sufficient to allow for a review. However, the field inspection found that as-built conditions differed slightly from the plans. Consequently, the original design calculations were revised to reflect the field data collected for the evaluation of the structure.

c. Validity. The design plans did not totally agree with the findings of the visual inspection. For example, the width of the emergency spillway is shown on the plans as 38 feet, while it was measured as 75 feet during the field inspection. The horizontal alignment of the emergency spillway at the dam site appears to differ slightly from what is shown on the plans. On the plans, the alignment of the emergency spillway is shown on a skew angle pointing away from the toe of the dike. The alignment at the site appears to be almost perpendicular to the axis of the dike. Also, based on field measurements, the crest of the dam is at elevation 107.9. The plans show the crest of the dam as slightly cambered with elevations ranging from 109 to 109.4.

A toe drainage system was installed beneath the downstream toe. Drains are 6 inch C.M.P.

A cutoff trench extends along the centerline from foundation grade to a minimum depth of 3 feet for the main dam and to bedrock for the dike. At the abutments the minimum depth of cutoff is 4 feet. The soil material used for the cutoff is not known. It may have been the lacustrine clay found below the dike.

h. Diversion and Regulating Tunnel

Not applicable.

i. Spillway

(1)	Type	Saddle
(2)	Length of Weir	75 feet
(3)	Crest elevation (no flash boards)	105.4
(4)	Gates	None
(5)	Upstream Channel	3% Slope
(6)	Downstream Channel	2.7% Slope

j. Regulating Outlets

There is no operating mechanism for control of the outlet. The concrete weir automatically controls flows less than 50 cfs. Since the pipe capacity is approximately 52 cfs, all flows greater than that value exit via the emergency spillway.

(4)	Top of dam el. 107.9	775
(5)	Test flood pool el. 108.7	800

e. Storage (acre-feet)

(1)	Normal pool	63
(2)	Flood control pool	N/A
(3)	Spillway crest pool	65
(4)	Top of dam	88
(5)	Test flood pool	95

f. Reservoir Surface (acres)

(1)	Normal pool (el. 104.0)	5.9
(2)	Flood control pool	N/A
(3)	Spillway crest (el. 105.4)	6.2
(4)	Test flood pool(el. 108.7)	7.2
(5)	Top of dam (el. 107.9)	6.8

g.

Dam		Main Dam	Dike
(1)	Type	Earth embankment	Earth embankment
(2)	Length	225 feet	200
(3)	Height	44 feet	18 feet
(4)	Top Width	10 feet	14
(5)	Side Slopes	2H:1V downstream 3H:1V upstream	2H:1V downstream 3H:1V upstream
(6)	Zoning	None	None
(7)	Impervious Core	None	None
(8)	Cutoff	10 ft. wide by 3 ft. deep	10 ft. wide x 4 ft. deep (to rock)
(9)	Grout Curtain	None	None

pipe size. The maximum capacity of the principal spillway is 52 cfs with a water surface at the top of dam (elevation 107.9 ft. NGVD).

(2) Maximum Known Flood. There were no records available nor were there any witnesses of any past flooding at the site.

(3) Spillway Capacity at Top of Dam. The emergency spillway is in the right abutment of the dike. The lowest point in the dam embankment is elevation 107.9. At that point, the principal spillway would discharge about 52 cfs and the emergency spillway would discharge about 890 cfs for a total capacity of 942 cfs.

4) Spillway Capacity at Test Flood Elevation. The full PMF test flood for the 540 acre drainage basis is 2150 cfs inflow. Surcharge storage of 29 acre-feet will attenuate the peak outflow to 2075 cfs at elevation 108.7 NGVD which causes an overtopping of the dam by 0.8 feet. The spillways will contribute 1405 cfs (68%) of the routed test flood outflow (2075 cfs).

(5) Total Project Discharge. The total project discharge at the top of dam (elevation 107.9) is 942 cfs. During the test flood, an inflow of 2150 cfs will produce a total project outflow of 2075 cfs at elevation 108.7.

c. Elevation (NGVD)

(1)	Streambed at toe of dam	64
(2)	Bottom of cutoff (assumed)	70
(3)	Maximum tailwater	N/A
(4)	Recreation pool	104.0
(5)	Full flood control pool	N/A
(6)	Spillway crest (ungated)	105.4
(7)	Design surcharge (Original Design)	106.5
(8)	Top of Dam	107.9
(9)	Test flood design surcharge	108.7

d. Reservoir (Length in feet)

(1)	Normal pool el. 104.0	700
(2)	Flood control pool	N/A
(3)	Spillway crest pool el. 105.4	725

c. Size Classification. Keyser Dam is 44 feet high and has a storage capacity of 88 acre-feet. In accordance with Article 2.1.1 of the Recommended Guidelines for Safety Inspection of Dams, the dam is Intermediate in size based upon its height, which is greater than 40 feet and less than 100 feet.

d. Hazard Classification. The dam has a hazard classification of High. The flood wave down Bicknell Brook would be approximately 6.2 feet high. Within the 1½ miles downstream between the dam and the river lie one or two houses which would be affected by the flood wave. It is possible that more than a few (about five) lives may be lost if the dam is breached.

e. Ownership. This dam is owned by F. Ray Keyser, Jr. His office address is The Honorable F. Ray Keyser, Jr., Keyser, Crowley, Bard & Kenlan, 27 South Main Street, Rutland, Vermont 05701; telephone number 802/773-2723.

f. Operator. This dam is operated by the owner, F. Ray Keyser, Jr. His home address is Chelsea, Vermont, 05038; telephone number 802/685-4825.

g. Purpose. Keyser Dam forms a permanent lake which is used for yearround recreation.

h. Design and Construction History. The dam was designed in 1963 by the USDA, Soil Conservation Service for the owner. It was constructed by the owner, who acted as the general contractor, during 1964 and 1965. Due to seepage that was observed on the downstream side of the dam, the Owner added fill near the toe a few years after construction. (See Section 3.1b and 6.3).

i. Normal Operating Procedure. There are no moving parts or mechanical controls on Keyser dam. A weir which surrounds the inlet of the corrugated metal pipe maintains a constant pool elevation approximately 4.3 feet below the top of the dam and approximately 1.4 feet below the level of the emergency spillway.

1.3 Pertinent Data

a. Drainage Area. The drainage area of Keyser Dam includes an area of 540 acres (0.84 square miles). The land is generally forested and the terrain is mountainous. There is no development upstream of the dam except for the recreational cottage along the lake shore.

b. Discharge at the Dam Site

(1) Outlet Works. A 24-inch diameter corrugated metal pipe serves as the principal spillway and primary outlet for the dam. For low flows (less than 50 cfs), the concrete weir surrounding the pipe inlet provides automatic control. Higher discharges (above 50 cfs) are controlled by the

NATIONAL DAM INSPECTION PROGRAM
PHASE I INSPECTION REPORT
KEYSER DAM

SECTION 1
PROJECT INFORMATION

1.1 General

a. Authority. Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a National Program of Dam Inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. DuBois & King, Inc., has been retained by the New England Division to inspect and report on selected dams in the State of Vermont. Authorization and notice to proceed were issued to DuBois & King, Inc., under a letter of October 19, 1977, from William E. Hodgson, Jr., Colonel, Corps of Engineers. Contract No. DACW33-80-C-0003 has been assigned by the Corps of Engineers for this work.

b. Purpose

(1) To perform technical inspection and evaluation of non-Federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-Federal interests.

(2) To encourage and prepare the states to quickly initiate effective dam safety programs for non-Federal dams.

(3) To update, verify and complete the National Inventory of Dams.

1.2 Description of the Project

a. Location. Keyser Dam is located on Bicknell Brook in the Town of Chelsea, Vermont, appproximately one and one-half miles upstream from its confluence with the First Branch White River. The dam is located on the 15-minute USGS quadrangle for Strafford, Vermont at coordinates 43° 57.1' north latitude, 72° 26.1' west longitude, Orange County, Vermont. The location of Keyser Dam, a private recreational lake, is shown on the Location Map immediately preceeding this page.

b. Description of Dam and Appurtenances. Keyser Dam is an earth embankment with a top width of 14 feet, an upstream slope of 3H:1V and a downstream slope of 2H:1V. It has a 24-inch diameter corrugated metal pipe with a metal baffle that serves as the principal spillway, an earth dike to the right of the knoll which forms the right abutment, and a 75-foot-wide emergency spillway located in the right abutment of the dike. The structural height of the dam is 44 feet, and the structural height of the dike is 18 feet. The principal spillway is ungated.

DuBois & King Inc.
engineering and environmental services
RANDOLPH, VERMONT · CONCORD, NEW HAMPSHIRE

NATIONAL DAM INSPECTION PROGRAM

KEYSER DAM

LOCATION MAP

USGS QUAD - STRAFFORD VERMONT

DRAWN BY: JAS	DATE: 1/80
CHECKED BY: RMC	PROJ. NO.: 9115
PROJ. ENG.	DRWG. NO.

SCALE: 1" = 62500'

SECTION 6

EVALUATION OF STRUCTURAL STABLITY

6.1 Visual Observations

Based on visual observations there are several features of this dam that need attention relative to its long-term stability.

First, the emergency spillway may erode if it were ever called upon to function at design capacity. This design should be checked.

Second, the exit point of the water supply pipe in the main dam should be monitored frequently, and a record maintained, to determine whether any seepage is developing. The details of the original installation of this pipe are not known. If anti-seepage precautions were not taken, a seep could develop at this point and lead to washout of the dam. Repairs should be made as needed to avoid difficulty at this location.

No cracks or signs of movement were noted in the concrete intake structure. The anti-vortex plate over the center of the concrete intake structure was rusted and should be painted. The wood trash rack around the intake structure is deteriorated and ineffective. A new trash rack should be installed.

6.2 Design and Construction Data

The design drawings show that the drain pipes in the toes of the Main Dam and the Dike are near the center of the free-draining soils that collect the water. Therefore, the drain pipes do not get the opportunity to gather all (or most) of the water flowing toward the drainage trenches. This may be one reason why seepage bypasses the drains and exits at, and downstream from, the toe.

A flap valve was shown on the low-level outlet in the design drawings. It was not installed because of the damage to the upstream end of the pipe during construction. (This information was supplied by Mr. Keyser.) Due to this damage, the lowlevel outlet was plugged on the upstream and downstream ends and does not function at present (see Section 3.1). This flap valve, or a more substantial control, should be installed at the upstream end of the low-level outlet to permit drawdown of the pond. (A valve at the downstream end must not be used, since the pressure in the low-level outlet pipe then would remain at pond level. Subsequent leakage could lead to washout of the dam.)

6.3 PostConstruction Changes

Several years after construction was completed, about 10 to 12 years ago (1967 to 1969), the downstream face of the Main Dam developed sloughs, apparently due to seepage through the dam. These sloughs also may have been induced by frost effects.

As a result, the owner placed additional drains on the downstream face and covered them with a berm composed of "loam" to provide weight in the zone where sloughing occurred. These drains are still functioning. On the day of inspection the outlet from the drains was discharging clear water at less than ¼ gpm (Photo 7). However, the entire toe of the berm is wet and somewhat soft. Therefore, the drains are not intercepting all the water that is seeping through the Main Dam.

The berm material apparently was not pervious since it was referred to as "loam". If the berm material was less pervious than the dam itself, then the presence of the berm may be deleterious to the dam. For this reason, a study should be undertaken to check whether this berm and the drains are functioning properly and to take any necessary corrective measures.

6.4 Seismic Stability

This dam is in Seismic Zone 2 and, hence, according to the applicable guidelines, a seismic stability analysis is not warranted.

SECTION 7

ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition. This dam is in fair condition. The test flood overtops the dam by 0.8 feet and certain features need investigation and repair.

b. Adequacy of Information. This inspection report was based on visual observations, the design drawings and specifications, and the construction and post-construction verbal history provided by the owner. All of this information was useful in the preparation of this report.

c. Urgency. The recommendations given in Section 7.2 and 7.3 should be carried out within one year after receipt of this report.

7.2 Recommendations

The following investigations and needed corrections should be performed under the direction of a registered engineer qualified in the design and construction of dams:

(1) Evaluate the erodability of the emergency spillway and the feasibility of directing spillway flow away from the toe of the dam.

(2) Design and implement repairs to the low-level outlet to make it operable.

(3) Evaluate the effectiveness of the berm and toe drains on the downstream side of the Main Dam and make necessary repairs. Monitor all seeps until this work has been completed.

(4) Determine whether any action should be taken relative to potential seepage adjacent to the water supply pipe that passes through the Main Dam and implement necessary repairs.

(5) Investigate the condition of the upstream slope protection and the need for improvement.

(6) Evaluate and increase earthfill as required on the downstream end of the 24-inch outlet conduit to protect if from collapsing if traffic passes over it.

7.3 Remedial Measures

a. Operating and Maintenance Procedures

(1) Trees and brush should be cleared annually from year all surfaces of the dam and to a distance of about 20 feet downstream from the toe.

(2) Clear debris from downstream channel.

(3) The anti-vortex steel plate should be cleaned of rust and protective paint applied.

(4) Institute a program of annual technical inspection.

(5) Establish written procedures for operating and maintaining the structure.

(6) Develop formal surveillance and downstream flood warning plans, including round-the-clock monitoring during heavy precipitation.

7.4 Alternatives

There are no practical alternatives to the above stated recommendations in 7.2 and 7.3.

APPENDIX A

VISUAL CHECKLIST WITH COMMENTS

INSPECTION CHECKLIST

PARTY ORGANIZATION

PROJECT Keyser Dam

DATE October 30, 1979

TIME 0920

WEATHER 40°, Overcast

W.S. ELEV. _____ U.S. ___ DN.S.

PARTY:

1. John Bilotta D&K
2. Jon Somaini, D&K
3. Elroy Langdell, Knight Engineering Inc.
4. Steve Poulos, GEI
5. F Ray Keyser, Owner
6. A. Peter Barranco, Vt. Dept. of Water Resources
7. _____
8. _____
9. _____
10. _____

PROJECT FEATURE	INSPECTED BY	REMARKS
1. Dam Embankment	S. Poulos	
2. Dike Embankment	S. Poulos	
3. Intake Structure	E. Langdell	
4. Hydrologic	J. Bilotta	
5.		
6.		
7.		
8.		
9.		
10		

INSPECTION CHECKLIST

PROJECT Keyser Dam

DATE October 30, 1979

PROJECT FEATURE

NAME J. Bilotta

DISCIPLINE

NAME S. Poulos

NAME E. Langdell

AREA EVALUATED	CONDITIONS
DAM EMBANKMENT	(Station zero is at angle point on knoll on top of dam.)
Crest Elevation	107.9
Current Pool Elevation	104.0
Maximum Impoundment to Date	Unknown
Surface Cracks	None observed.
Pavement Condition	None.
Movement or Settlement of Crest	None observed.
Lateral Movement	None observed.
Vertical Movement	Slight slope down from left to right toward right abutment.
Horizontal Alignment	Satisfactory.
Condition at Abutment and at Structures	Not observable at concrete intake structure. Right:satisfactory. No seepage at contact. Left: satisfactory. Also satisfactory at overflow pipe exit downstream. A water supply pipe passes through dam at 1+50 Lt. and 15 ft.down from crest. It is a 1-inch diameter galvanized iron pipe. No knowledge of whether anti-seep collars were provided. No seepage exiting adjacent to pipe on downstream side.
Indications of Movement of Structural Items on Slopes	None observed.
Trespassing on Slopes	Free access. Woodchuck hole 6-inch diameter at 1+25 left. 35' right of axis (downstream) 4' deep. No other holes observed.

INSPECTION CHECKLIST

PROJECT Keyser Dam

DATE October 30, 1979

PROJECT FEATURE

NAME J. Bilotta

DISCIPLINE

NAME S. Poulos

NAME E. Langdell

AREA EVALUATED	CONDITIONS
DAM EMBANKMENT (continued)	
Sloughing or Erosion of Slopes or Abutments	Upstream o.k. Abutments - none. Downstream slope very irregular. From 0+50L to 1+25L downstream appears bulged out. Remainder 1+25L to left abutment is steep and smooth. Owner indicated that toe of dam from 1+25L to 1+75L sloughed, with scarps forming, about 10-12 years ago. He installed 4-inch bitumastic drain pipes leading to toe drain exit and back-filled with "loam". Therefore, the former toe is covered with this fill and there is a break in slope of the dam where downstream slope intersects top of fill.
Rock Slope Protection-Riprap Failures	Same as for dike. Some parts of shoreline at left and right side have no granite.
Unusual Movement or Cracking at or Near Toe	Refer to "Sloughing or Erosion of Slopes or Abutments."
Unusual Embankment or Downstream Seepage	None on embankment. Entire toe of fill placed 10-12 years ago is wet with puddles of water, not visibly moving.
Piping or Boils	None observed.
Foundation Drainage Features	None.
Toe Drains	Plans show toe drains. Exit pipe is at 1+70L running about 5 gpm. New toe drains installed by owner are Orange-burg pipe 4" dia. 1.8' above invert of toe drain exit, flowing at ±¼ gpm. Oriented N55W.
Instrumentation System	None.
Vegetation	Low brush and grass.

INSPECTION CHECKLIST

PROJECT Keyser Dam

DATE October 30, 1979

PROJECT FEATURE

NAME J. Bilotta

DISCIPLINE

NAME S. Poulos

NAME E. Langdell

AREA EVALUATED	CONDITIONS
DIKE EMBANKMENT	
Crest Elevation	107.9
Current Pool Elevation	104.0
Maximum Impoundment to Date	Unknown
Surface Cracks	None observed.
Pavement Condition	None.
Movement or Settlement of Crest	Crest sloped slightly downwards upstream. Slight dip in crest at Sta 0+75R by approximately 0.5 ft.
Lateral Movement	None observed. Dam has very slight upstream arch.
Vertical Alignment	See "Movement or Settlement of Crest."
Horizontal Alignment	Appears satisfactory
Condition at Abutment	Left - satisfactory. Right - downstream slight dampness at contact line. No seepage. Upstream, o.k.
Indications of Movement of Structural Items on Slopes	No structures on slopes.
Trespassing on Slopes	Free access. No animal holes observed.
Sloughing or Erosion of Slopes or Abutments	None observed.
Rock, Slope Protection - Riprap Failures	No riprap in design. Owner placed flat granite slabs (2x4 to 3x10 ft) at waterline to prevent wave cut.
Unusual Movement or Cracking at or Near Toes	None observed.
Embankment or Downstream Seepage	None observed.
Piping or Boils	None observed.
Foundation Drainage Features	None.
Toe Drains	Plans show two toe drains. Exit points are at downstream toe, of right abutment contact line. Left one is flowing at approx. 1 gpm, right one at approx. 2 gpm. Low-level outlet is plugged with wood and buried about 10 ft. upstream.

INSPECTION CHECKLIST

PROJECT Keyser Dam

DATE October 30, 1979

PROJECT FEATURE

NAME J. Bilotta

DISCIPLINE

NAME S. Poulos

NAME E. Langdell

AREA EVALUATED	CONDITIONS
DIKE EMBANKMENT (continued)	
Instrumentation System	None
Vegetation	Low brush and grass.

INSPECTION CHECKLIST

PROJECT Keyser Dam

DATE October 30, 1979

PROJECT FEATURE

NAME J. Bilotta

DISCIPLINE

NAME S. Poulos

NAME E. Langdell

AREA EVALUATED	CONDITIONS
OUTLET WORKS - INTAKE CHANNEL AND INTAKE STRUCTURE FOR PRINCIPAL SPILLWAY	(Principal spillway controls pond level under normal conditions.) There was a low-level outlet for this dam but it was plugged because it was damaged during construction.
a. Approach Channel	
Slope Conditions	Grassed. Upstream slope of dam.
Bottom Conditions	Lake bottom. Upstream slope of dam 1:3.
Rock Slides or Falls	None.
Log Boom	None. No trash rack.
Debris	None.
Condition of Concrete Lining	No lining.
Drains or Weep Holes	N/A
b. Intake Structure	
Condition of Concrete	Good
Stop Logs and Slots	None
	No cracks in the concrete were noted. The antivortex plate is rusting and in need of protective paint. A non-functioning deteriorated wood trash rack is present.

INSPECTION CHECKLIST

PROJECT Keyser Dam

DATE October 30, 1979

PROJECT FEATURE

NAME J. Bilotta

DISCIPLINE

NAME S. Poulos

NAME E. Langdell

AREA EVALUATED	CONDITIONS
OUTLET WORKS - CONTROL TOWER	None.
a. Concrete and Structural	
General Condition	
Condition of Joints	
Spalling	
Visible Reinforcing	
Rusting or Staining of Concrete	
Any Seepage or efflorescence	
Joint Alignment	
Unusual Seepage or Leaks in Gate Chamber	
Cracks	
Rusting or Corrosion of Steel	
b. Mechanical and Electrical	
Air Vents	
Float Wells	
Crane Hoist	
Elevator	
Hydraulic System	
Service Gates	
Emergency Gates	
Lightning Protection System	
Emergency Power System	
Wiring and Lighting System	

INSPECTION CHECKLIST

PROJECT Keyser Dam

DATE October 30, 1979

PROJECT FEATURE

NAME J. Bilotta

DISCIPLINE

NAME S. Poulos

NAME E. Langdell

AREA EVALUATED	CONDITIONS
OUTLET WORKS - TRANSITION AND CONDUIT	This item refers to the 24-inch diameter C.M.P. that drains the principal spillway.
General Condition of CMP.	Satisfactory.
Rusting or Staining of CMP	Slight
Spalling	Not applicable.
Erosion or Cavitation	Not applicable
Cracking	None.
Alignment of Monoliths	Not applicable.
Alignment of Joints	Visble portion is satisfactory.
Numbering of Monoliths	Not applicable.
Seepage Around Outlet of CMP	No flow visible. However, ground beneath pipe upstream from outlet end is damp and has rusty staining.

INSPECTION CHECKLIST

PROJECT Keyser Dam

DATE October 30, 1979

PROJECT FEATURE

NAME J. Bilotta

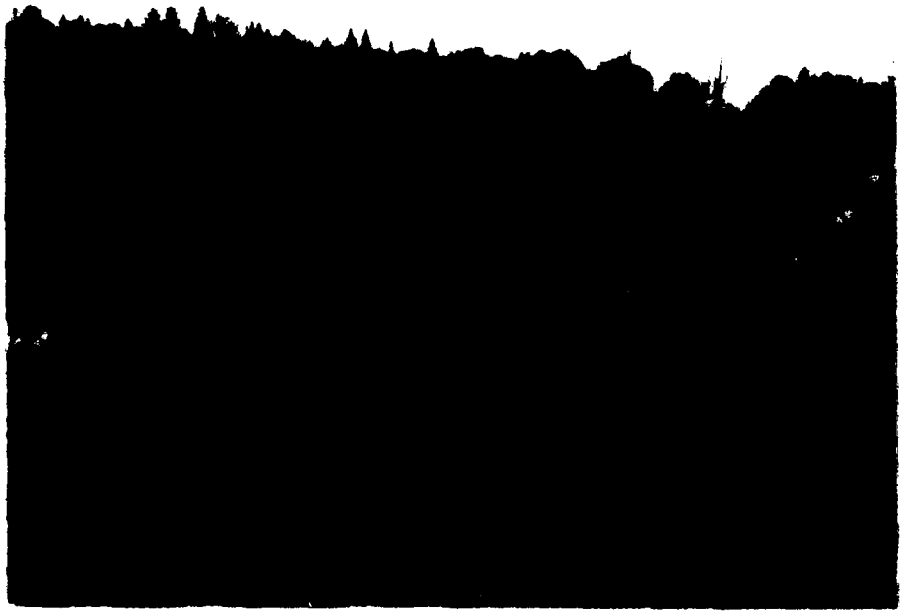
DISCIPLINE

NAME S. Poulos

NAME E. Langdell

AREA EVALUATED	CONDITIONS
OUTLET WORKS - OUTLET CHANNEL FOR 24-INCH CMP	No outlet structure as such.
General Condition of Concrete	No Concrete.
Rusting or Staining	
Spalling	
Erosion or Cavitation	
Visible Reinforcing	
Any Seepage or Efflorescence	
Condition at Joints	
Drain holes	N/A
Channel	
Loose Rock or Trees Overhanging Channel.	No rock. Trees overhanging channel.
Condition of Discharge Channel	Small natural stream channel wooded both sides.

#1 VIEW OF DOWNSTREAM FACE FROM LEFT ABUTMENT

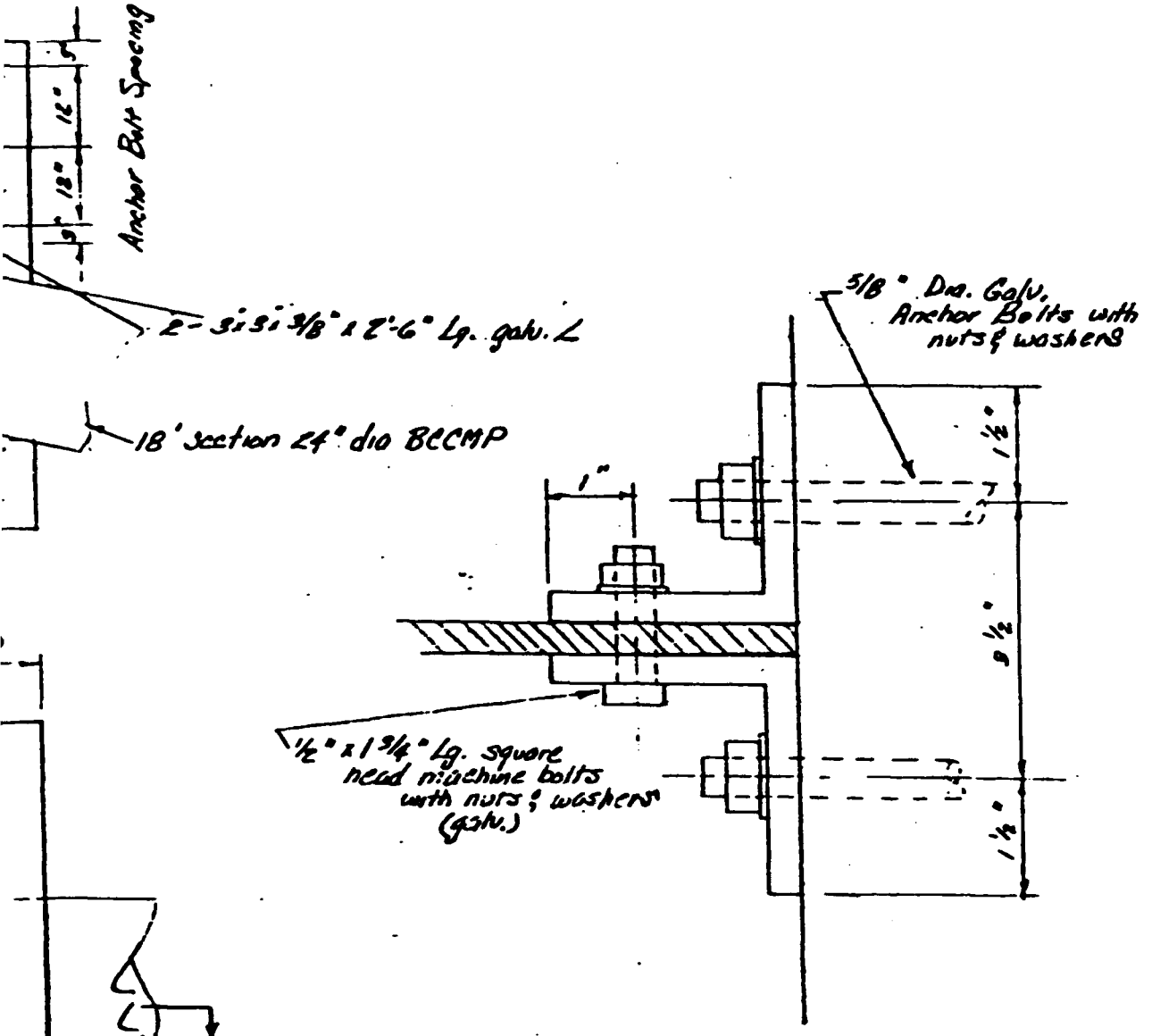


#2 VIEW OF TOP OF DIKE FROM RIGHT ABUTMENT

APPENDIX C

PHOTOGRAPHS

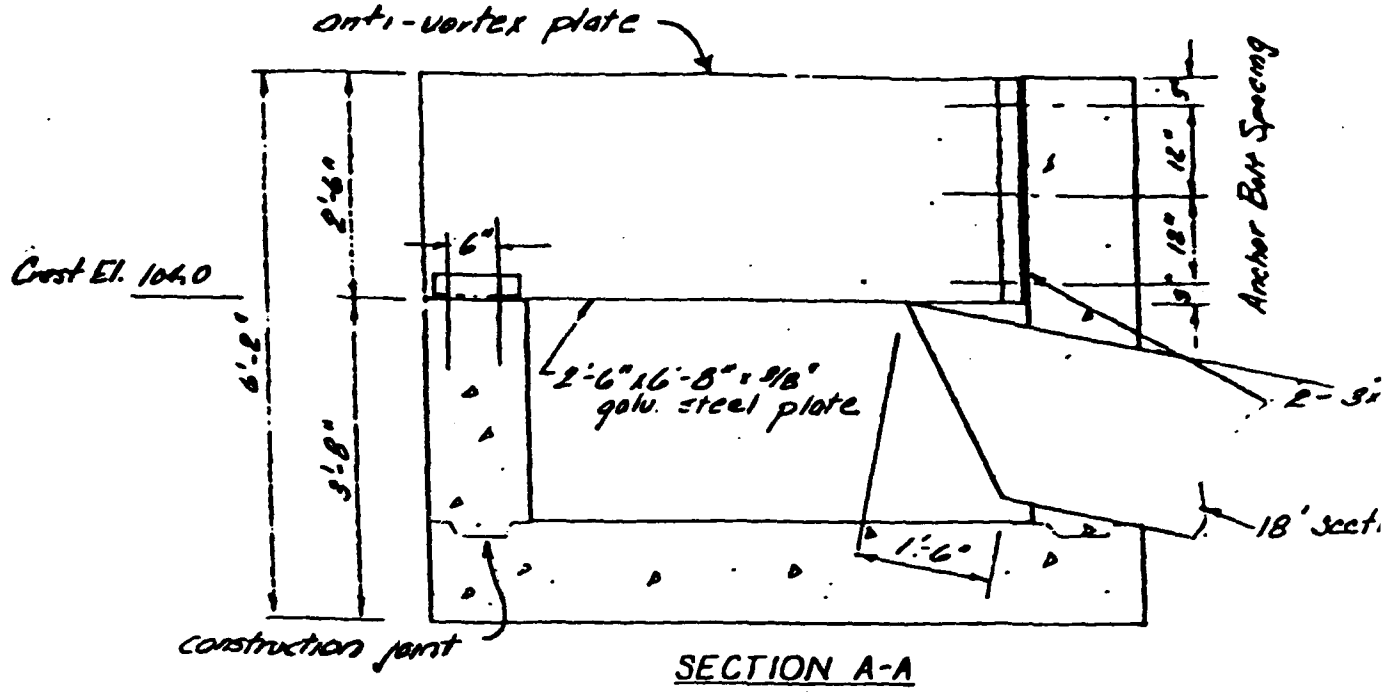
FOR LOCATION OF PHOTOS, SEE FIGURE B-1
LOCATED IN APPENDIX B



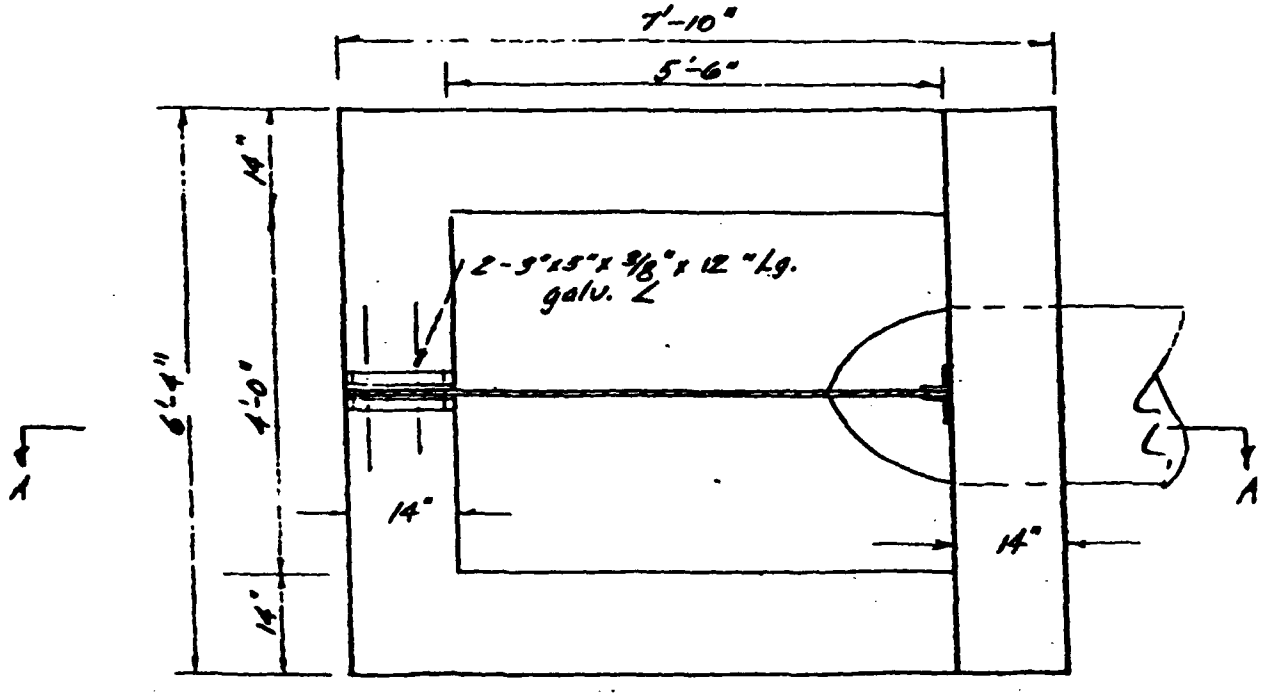
ANTI-VORTEX PLATE FASTENING DETAIL

Concrete volume - 5.39 C.Y.

Department of the Army New England Division Corps of Engineers Waltham, MA 02154	NATIONAL DAM INSPECTION PROGRAM KEYSER DAM CHELSEA, VERMONT DETAIL OF CONCRETE INLET	DRAWN BY JAS	DATE 1/80
		CHECKED BY RHC	FINAL NO. 91115
		FINAL APPR.	SHEET NO. B-3
		NOT TO SCALE	



SECTION A-A

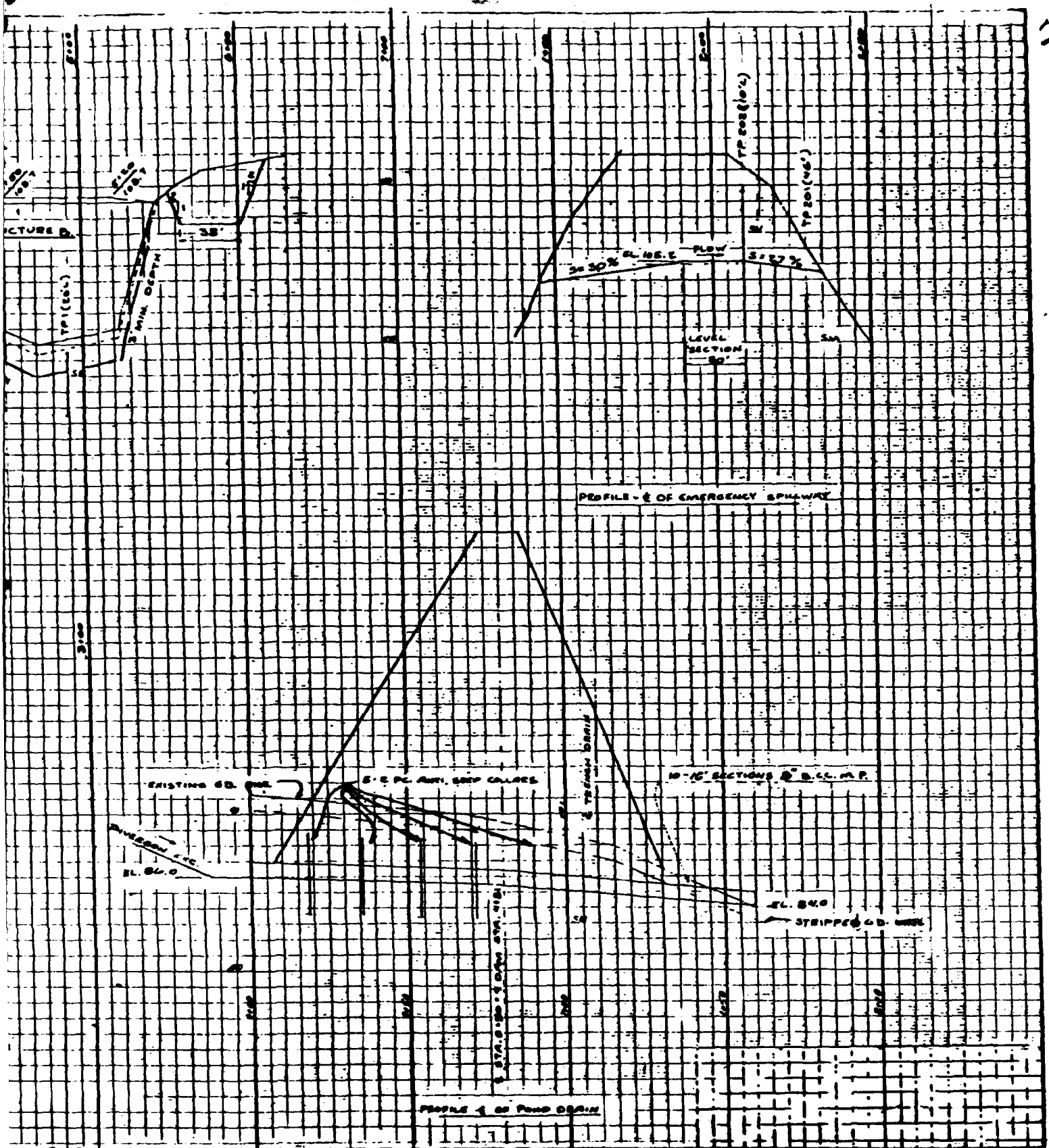


TOP VIEW

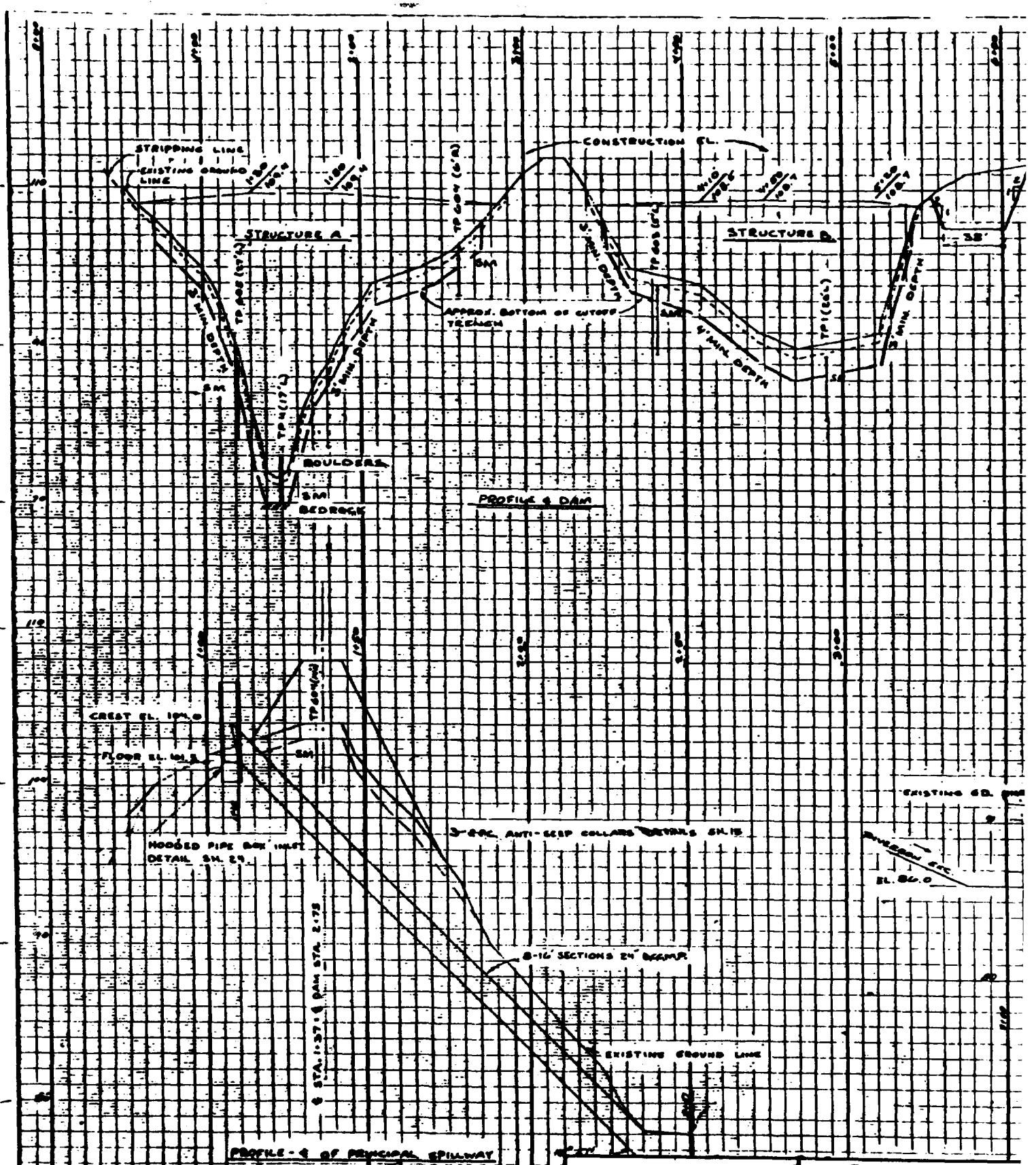
ORIGINAL DRAWING PREPARED
USDA SOIL CONSERVATION SERVICE 1963

DuBois & King Inc.
engineering and environmental services
RANDOLPH, VERMONT / CONCORD, NEW HAMPSHIRE

Department
New Engla
Corps of
Waltham,



Department of the Army New England Division Corps of Engineers Waltham, MA 02154	NATIONAL DAM INSPECTION PROGRAM KEYSER DAM CHELSEA, VERMONT PLAN AND ELEVATION VIEW
	1/80
	91115
	B-2
	NOT TO SCALE



ORIGINAL DRAWING PREPARED BY.
USDA SOIL CONSERVATION SERVICE, 1963

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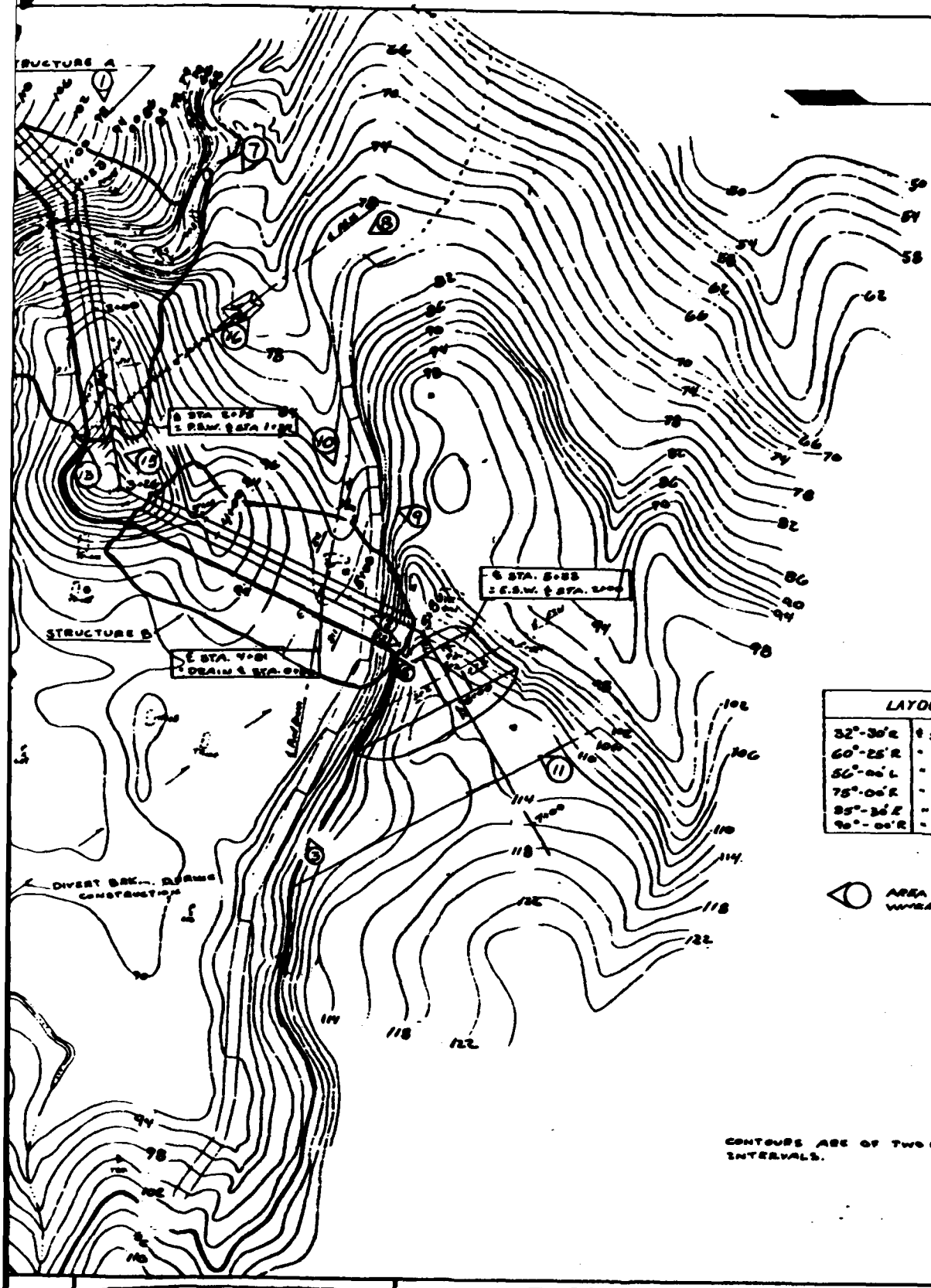
Department of the A
New England Divisi
Corps of Engineers
Waltham, MA 0215



LAYOUT DATA		
32°-30'R	℄ STA. 1+23	—
60°-25'R	" " 2+75	℄ P.S.W
56°-00'L	" " 3+26	—
75°-00'R	" " 4+81	℄ POND DRAIN
85°-30'R	" " 5+66	—
90°-00'R	" " 6+83	℄ E.S.W.

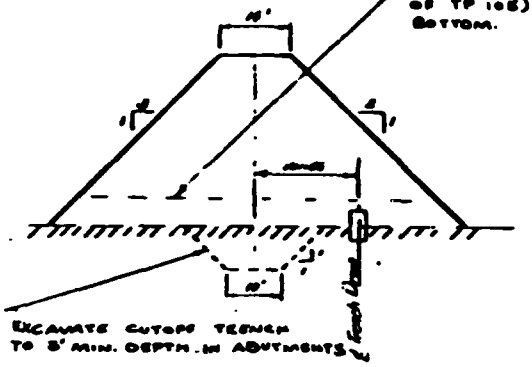
AREA WHERE PICTURES WERE TAKEN

Department of the Army
New England Division
Corps of Engineers
Waltham, MA 02154

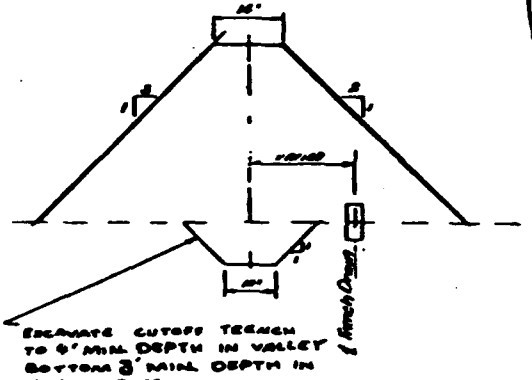
NATIONAL DAM INSPECTION PROGRAM
KEYSER DAM
CHELSEA, VERMONT
SITE PLAN

DRAWN BY JAS	DATE 1/80
CHECKED BY JJMC	PROJ. NO. 9111S
PROJ. ENG.	DRWG. NO. B-1

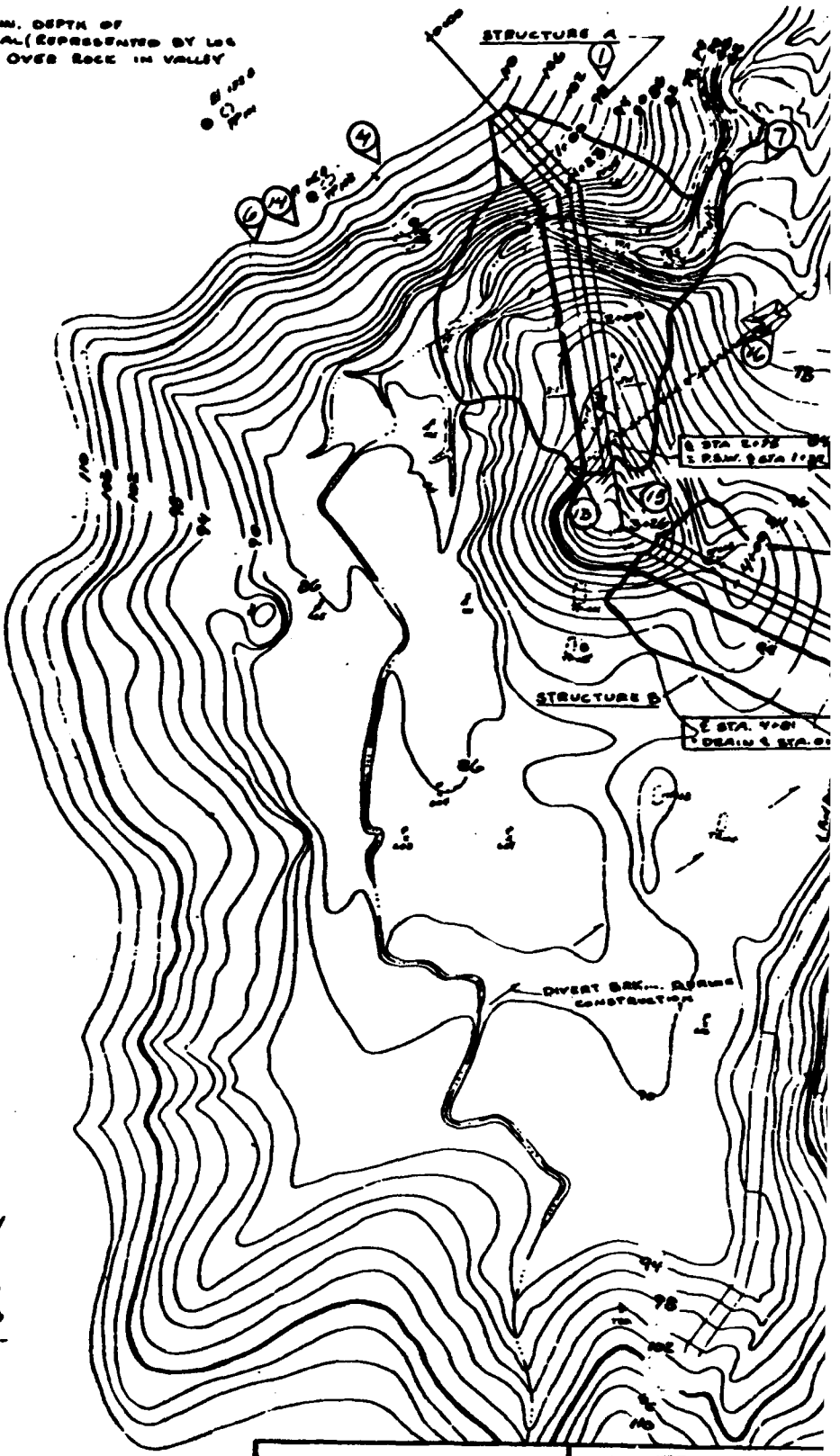
NOT TO SCALE



TYPICAL SECTION - STRUCTURE A



TYPICAL SECTION - STRUCTURE B



-Notes-

1. All fill to be compacted to 95% standard Proctor density or higher (ASTM designation D698)
2. Use available CL material (represented by the logs of TP 105) for cutoff trench & center portion of dam. Use SM material (represented by the logs of TP 101, 102, 103, & 108) in outer portions of dam.

DuBois & King INC.
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RANDOLPH, VERMONT / CONCORD, NEW HAMPSHIRE

Department of the
New England Divi
Corps of Engine
Waltham, MA 0

ORIGINAL DRAWING PREPARED BY.
USDA SOIL CONSERVATION SERVICE 1963

VERMONT DEPARTMENT OF WATER RESOURCES

INSPECTION REPORT

Name of Dam *Keyser Pond* Town *Chelsea Vt.*

Owner *F. Ray Keyser Jr.* Address *48 Oak street Proctor VT 05765*

U.S.G.S. Coorindates: Lat. ______ Long. ______

Inspected by *R. E. Wood S.C.T. SCS* Date ______

1. Condition of dam and spillway
   - a. erosion *a good job of erosion control has been done along the shore*
   - b. cracking *none*
   - c. leakage or seepage *~~some~~ at toe of slope - toe drains clogging*
   - d. brush or tree growth *yes popple & balm of gilead*
2. General operation
   - a. maintenance *- poor*
   - b. operating equipment
3. Settlement *none*
4. Downstream conditions
   - a. channel slope *OK*
   - b. channel width *OK*
   - c. obstructions *None*

Note
On the right abutment of the dam there are two gullies. One has been stoned up the other has not. Apparently surface water coming down a horse trail is causing the trouble. There is also a gully at the outlet end of the Emergency spillway caused by surface water runoff. Poor cover on the E. spillway also.

WR-35

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE 96 College Street, Burlington, Vermont 05401

November 15, 1971

Mr. John E. Cerutti, Director
Planning and Development Division
Dept. of Water Resources
State of Vermont
Montpelier, Vermont 05602

Dear John:

Enclosed is inspection report for F. Ray Keyser, Jr. dam in Chelsea, Vermont.

Sincerely,

Kenneth P. Wilson
State Conservation Engineer

ROUTING
GENERAL
TO | NOTED | DATE
DHS
JFC
SUSPEND TO
FILE

KPW:TRP

Enclosure

APPENDIX B

ENGINEERING DATA

Description	Location
1. Keyser Design Records*	Vermont Dept. of Water Resources State Office Building Montpelier, Vermont 05602
A. Preliminary Design Notes	
2. Past Inspection Records	
A. Keyser Dam Inspection Report	Appendix B, pages B-1,2
3. Plans	
A. Original Plans	
A.1. Keyser Dam - Plan View	Appendix B, page B-3
A.2 Keyser Dam Profile	Appendix B, page B-4
A.3 Detail of Concrete Inlet	Appendix B, page B-5
4. Subsurface Soils Information*	Vermont Dept. of Water Resources State Office Building Montpelier, Vermont 05602

* Information is also available from:

U.S. Conservation Service
1 Burlington Square
Suite 205
Burlington, Vermont 05401

APPENDIX B

ENGINEERING DATA

INSPECTION CHECKLIST

PROJECT Keyser Dam

DATE October 30, 1979

PROJECT FEATURE

NAME J. Bilotta

DISCIPLINE

NAME S. Poulos

NAME E. Langdell

AREA EVALUATED	CONDITIONS
OUTLET WORKS - SERVICE BRIDGE	none
a. Super Structure	
Bearings	
Anchor Bolts	
Bridge Seat	
Longitudinal Members	
Underside of Deck	
Secondary Bracing	
Deck	
Drainage System	
Railings	
Expansion Joints	
Paint	
b. Abutment & Piers	
General Condition of Concrete	
Alignment of Abutment	
Approach to Bridge	
Condition of Seat & Backwall	

INSPECTION CHECKLIST

PROJECT Keyser Dam

DATE October 30, 1979

PROJECT FEATURE

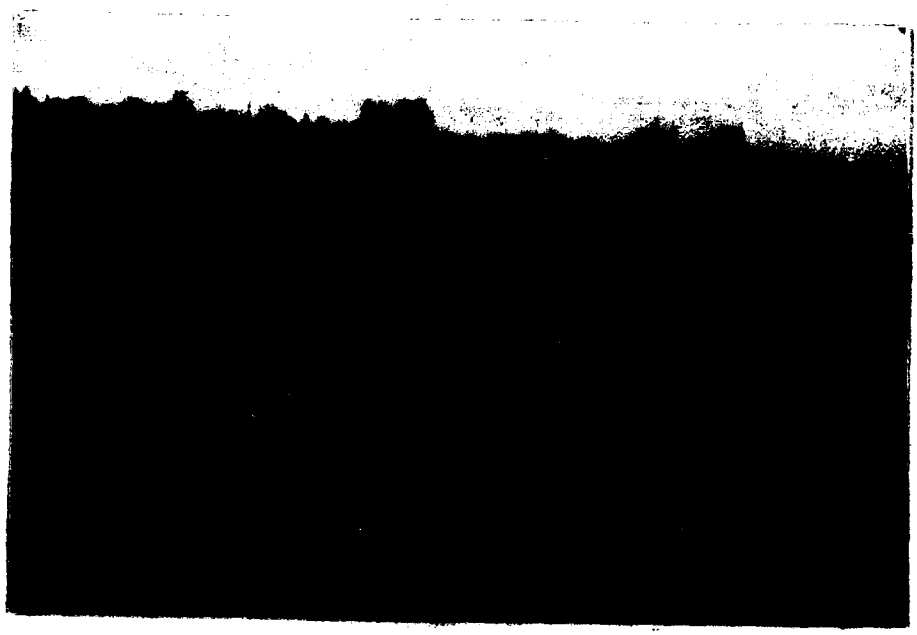
NAME J. Bilotta

DISCIPLINE

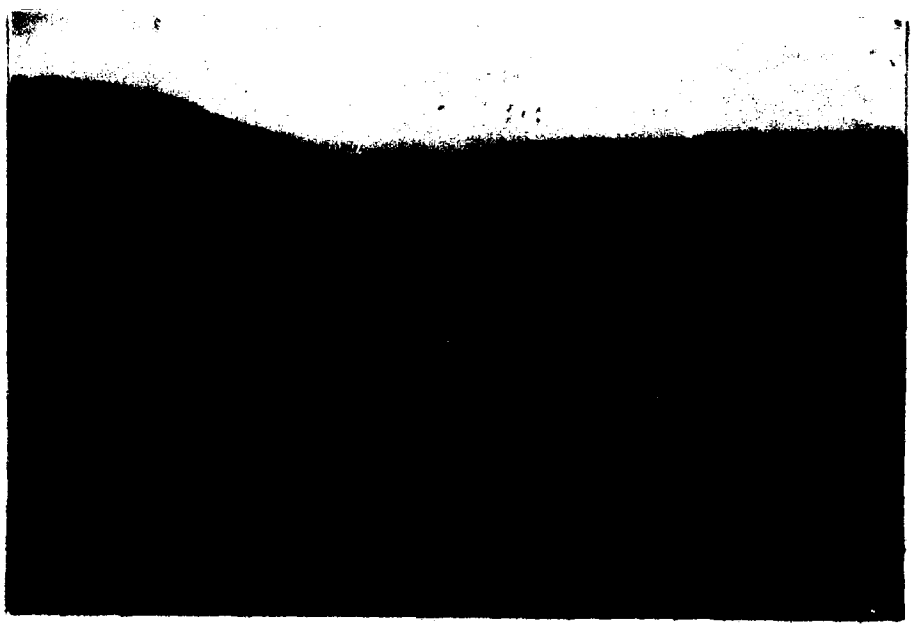
NAME S. Poulos

NAME E. Langdell

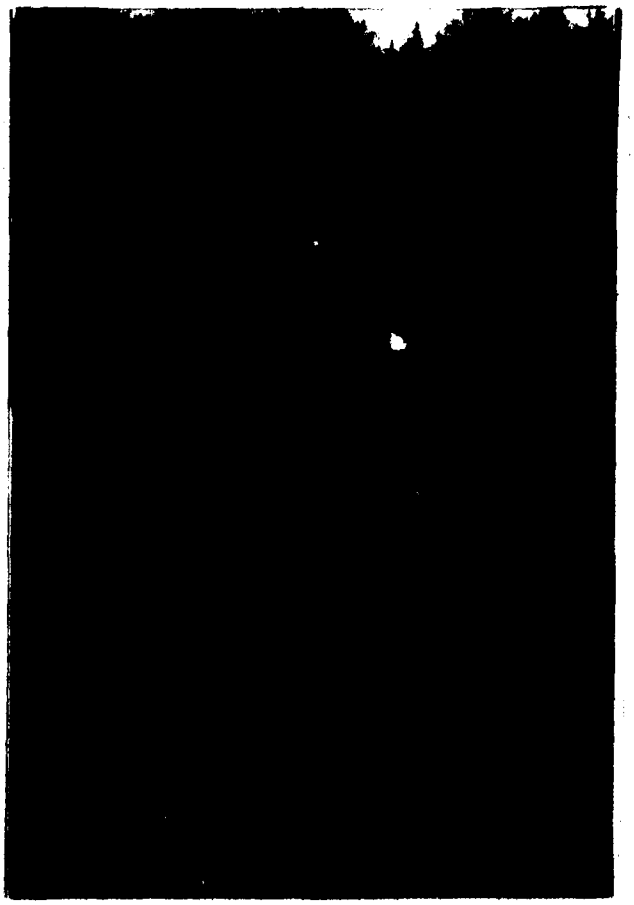
AREA EVALUATED	CONDITIONS
OUTLET WORKS - SPILLWAY, WEIR, APPROACH AND DISCHARGE CHANNELS	Emergency Spillway
a. Approach Channel	
General Condition	Below reservoir level.
Loose Rock Overhanging Channel	None.
Trees Overhanging Channel	None.
Floor of Approach Channel	Glacial till and grass. Grass is spotty.
b. Weir and Training Dikes	
General Condition	Glacial till and grass. Grass is spotty.
Rust or Staining	N/A
Spalling	N/A
Any Visible Reinforcing	N/A
Any Seepage	None observed.
Drain Holes	No drains in side dikes.
c. Discharge Channel	
General Condition	Satisfactory
Loose Rock Overhanging Channel	None.
Trees Overhanging Channel	None that are significant.
Floor of Channel	Grass on glacial till with small erosion rills.
Other Obstructions	None.



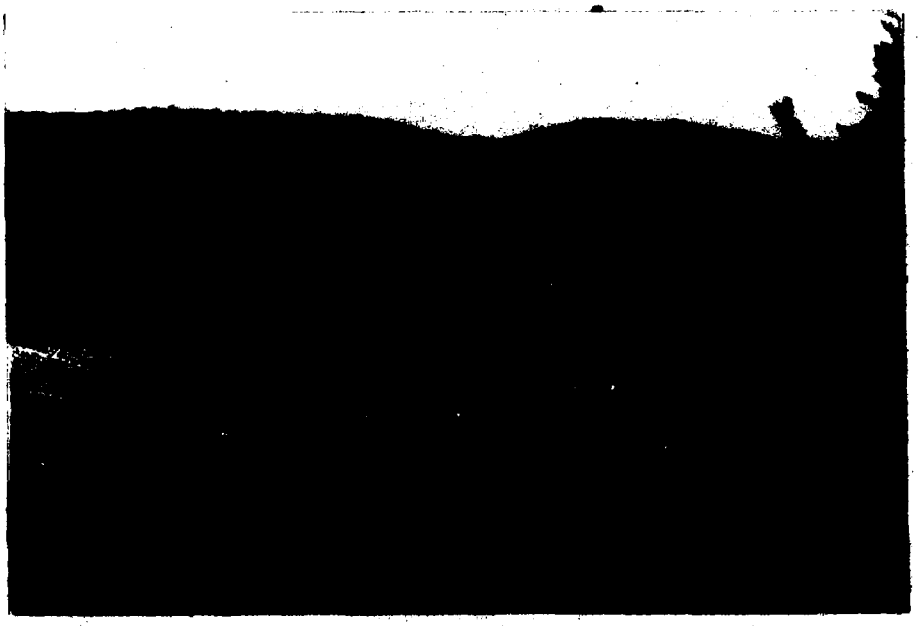
#3 UPSTREAM FACE OF DIKE FROM RIGHT ABUTMENT



#4 UPSTREAM FACE OF DAM FROM LEFT ABUTMENT



#5 ROCK SLOPE PROTECTION ON UPSTREAM FACE OF DAM



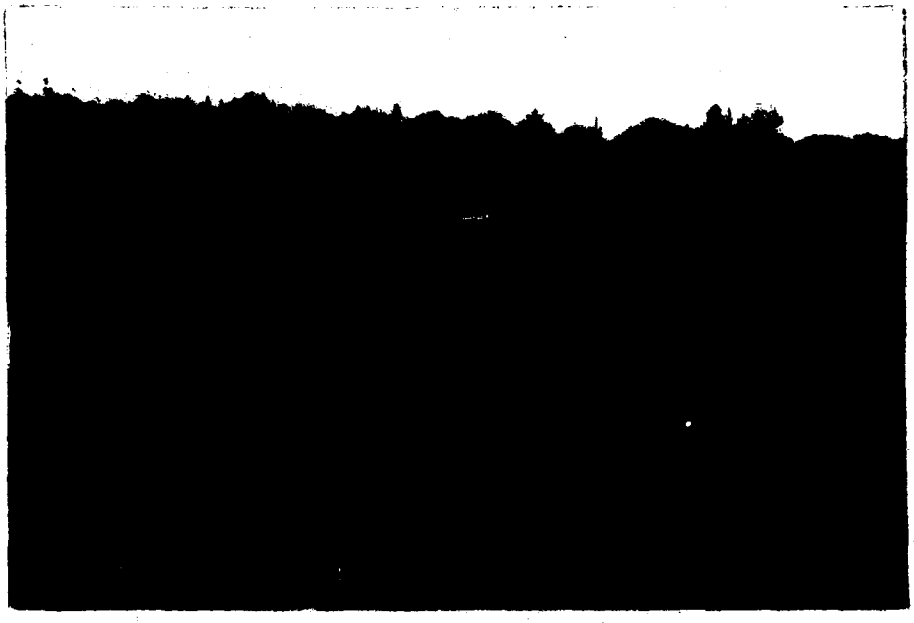
#6 LAKE AREA AS VIEWED FROM LEFT ABUTMENT

#7 TOE DRAIN FOR MAIN DAM

#8 OUTLET, LOOKING UPSTREAM

#9 DOWNSTREAM FACE OF DIKE

#10 TOE DRAINS FOR DIKE



#11 EMERGENCY SPILLWAY AS VIEWED FROM RIGHT TO LEFT

#12 EMERGENCY SPILLWAY AS VIEWED FROM LEFT TO RIGHT

#13 PRINCIPAL SPILLWAY FROM RIGHT

#14 PRINCIPAL SPILLWAY FROM LEFT

#15 HOODED INLET AND BAFFLE DETAIL

#16 OUTLET AND EXIT CHANNEL LOOKING DOWNSTREAM

APPENDIX D

HYDROLOGIC AND HYDRAULIC CALCULATIONS

Job No. 7115 Sheet 1 of 26
Project [illegible] Date 1/3/80
Subject [illegible] By kmc Ch'k. by

DRAINAGE AREA - From approximated location of dam on [illegible] creek on USGS MAP (15 minute) SCS design for 540 acres or 0.84 $mi.^2$ accepted after USGS map check.

DRAINAGE AREA = 0.84 $mi.^2$ = 540 acres

RESERVOIR CAPACITY DATA NEEDED

1) NORMAL POOL SURFACE AREA (acres)
2) EMERGENCY POOL SURFACE AREA (acres)
3) [illegible] POOL VOLUME (acre-ft.)
4) EMERGENCY POOL VOLUME (acre-ft)
5) ELEVATION (ft) VS STORAGE (acre-ft) CURVE
6) AREA (acres) VS ELEVATION CURVE

SCS-344 5-57
Tabular Computations

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

P.1

KEYSER POND

STORAGE COMPUTATIONS

JGB 7/29/63
GB 8/28/63

ELEV.	√I.N.	AREA (acres)	AVE AREA (acres)	CONTOUR INTERVAL (Ft)	STORAGE (A.ft)	TOTAL STORAGE (A.Ft)		
82	0.93	0.05				0.03		
			0.30	4	1.20			
86	9.44	0.54				1.23		
			1.13	4	4.52			
90	29.54	1.72				5.75		
			2.63	4	10.52			
94	61.79	3.54				16.27		
			4.01	4	16.04			
98	78.06	4.48				32.31		
			4.98	4	19.92			
102	95.45	5.47				52.23		
			5.66	2	11.32			
104	102.25	5.86				63.55		
			6.11	2	12.22			
106	110.77	6.35				75.77		
			6.56	2	13.12			
108	118.07	6.77				88.89		

B.J. GERMANA 7/63

U. S. GOVERNMENT PRINTING OFFICE: 1959 O - 501963

K·E 10 X 10 TO THE INCH 359-5DG
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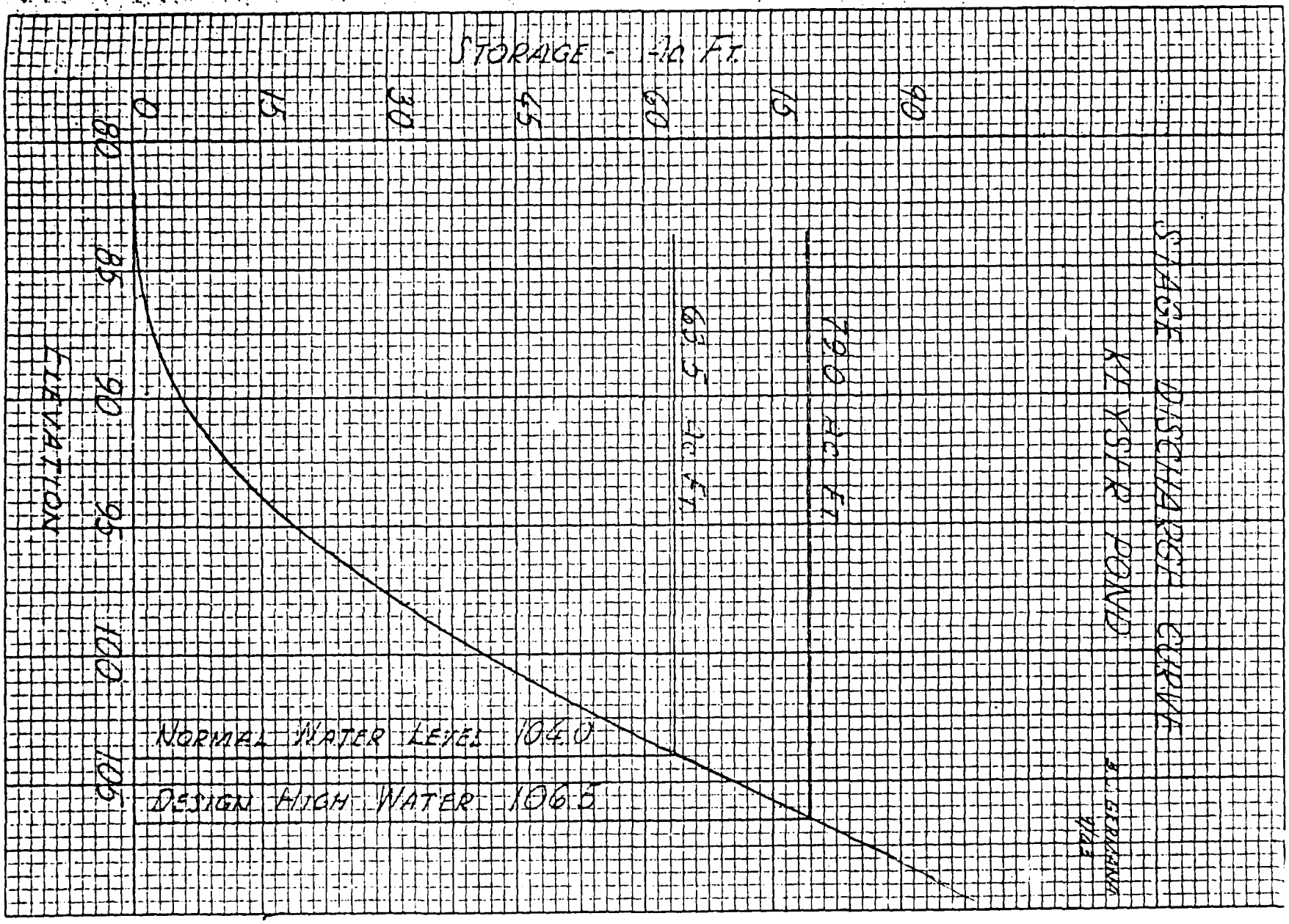
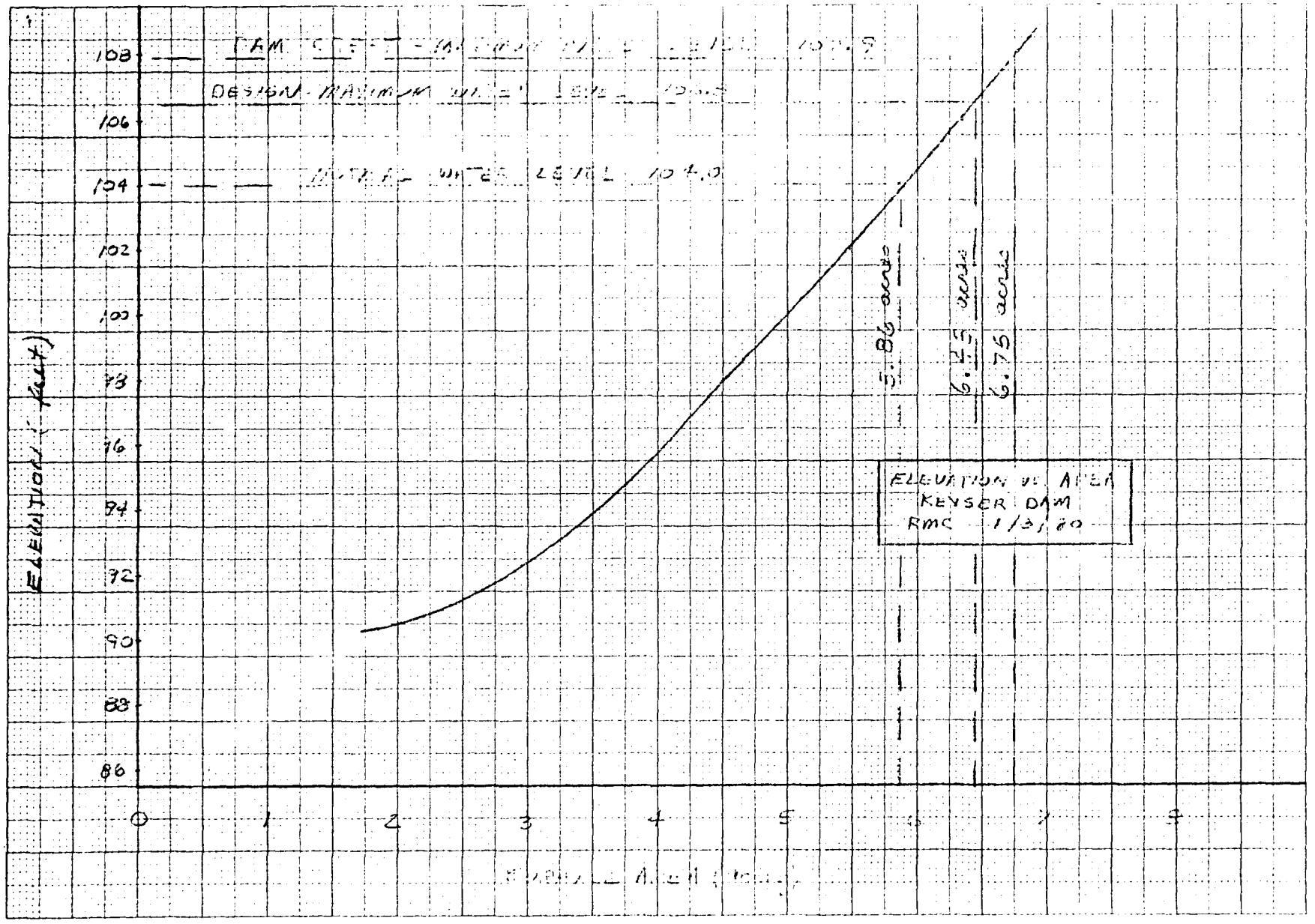
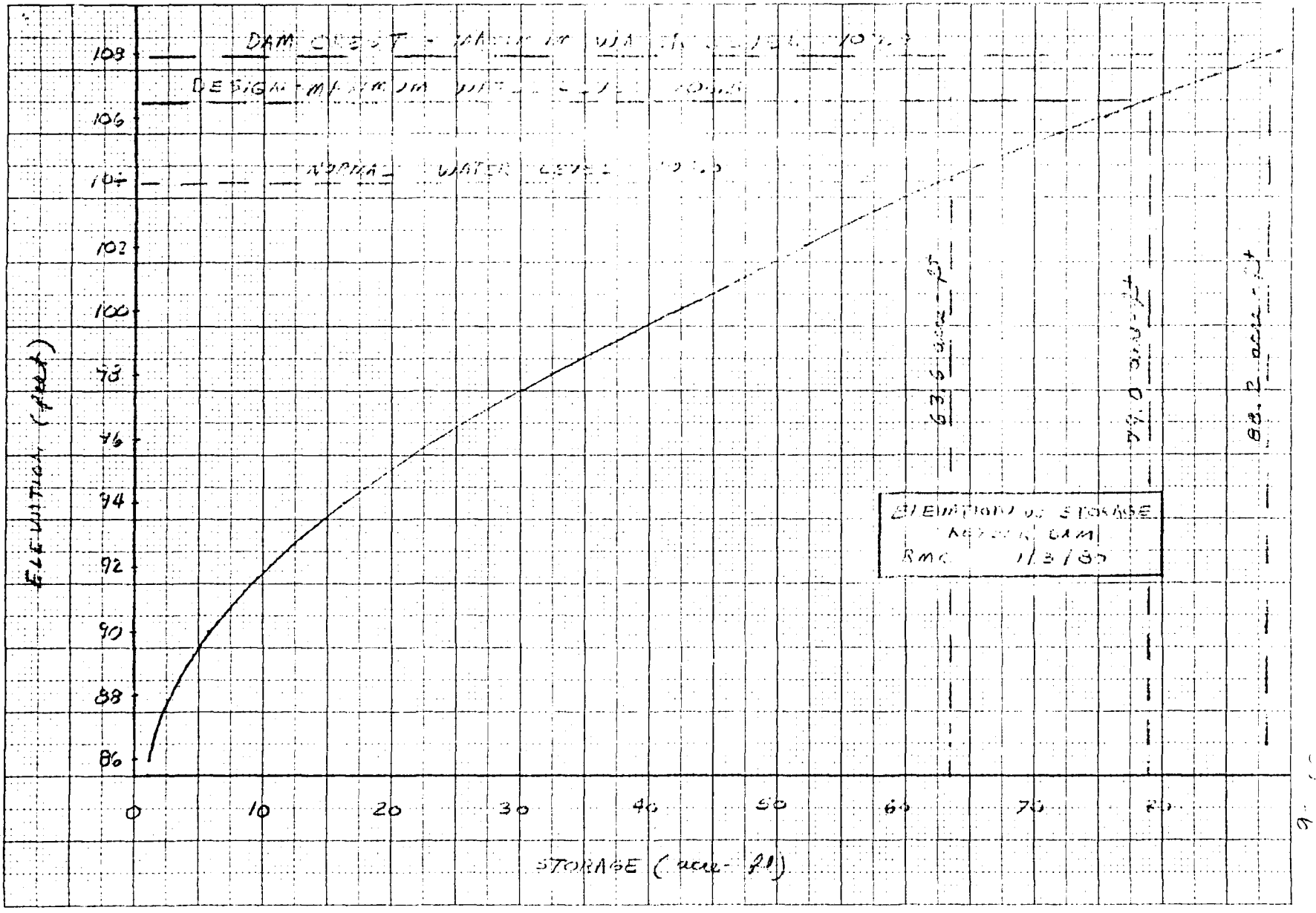



108
106
104
102
100
98
96
94
92
90
88
86
0
1
2
3
4
5
6
7
8
9
ELEVATION (ft.)
5.86 acres
6.25 acres
6.75 acres
ELEVATION vs. AREA
KEYSER DAM
RMC 1/3/80

K•E 10 X 10 TO INCH KEUFFEL & ESSER CO



Job No. 7115 Sheet 6 of 26
Project Keyser Dam Date 1/4/85
Subject Hydraulics / Hydrology By MC Ch'k. by

Keyser Dam located in Chelsea, UT on Bicknell Brook in the White River Basin

CLASSIFICATION: SIZE - INTERMEDIATE (based on storage) (10' > 40' > 40')

HAZARD - High (based upon isolated homes located along Bicknell Brook and the First Branch, White River, along with a secondary highway (VT110) and numerous agricultural establishments)

DRAINAGE AREA - 540 acres = .84 mi²

RESERVOIR - Normal pool elevation 104.0 (NOTE: SCS USED LOCAL ELEVATION SYSTEM, NOT TIED INTO ANY USGS DATUM)

STORAGE - 63.6 a-f

DESIGN MAXIMUM POOL Elevation 106.5'

ACTUAL MAXIMUM POOL ELEVATION 107.9' STORAGE 222 a-f
SURFACE AREA STORAGE 88.2a-f

NORMAL POOL ELEVATION 104.0'
AREA - 5.86 acres

DESIGN MAXIMUM POOL ELEVATION 106.5'
AREA - 6.45 acres

ACTUAL MAXIMUM POOL ELEVATION 107.9'
AREA - 6.75 acres

DAM - Earthfill w/ 3 on 1 upstream slope and 3 on 1 downstream slope
LENGTH = 225'
MAXIMUM HEIGHT - 44'
crest elevation - 107.9'

DIKE - Earthfill w/ 3 on 1 upstream slope and 3 on 1 downstream slope
LENGTH: 200'
MAXIMUM HEIGHT = 44'
crest elevation - 108.1'

OUTLETS - PRIMARY - ONE 24"ϕ SCCMP
INLET invert elevation - 104.0'
EMERGENCY - 75' long EARTH CHANNEL w/4 on 1 side slopes
invert elevation 105.4'

Job No. 91115 Sheet 20 of 26
Project Keyser Dam Date 1/6/80
Subject Hydraulics By RMC Ch'k. by

Reach 2 - Stage-Discharge Curve Calculations

Sample Calculation

$$Q_{CH} = \frac{1.49}{0.04}(67.5)\left(\frac{67.5}{27.8}\right)^{2/3}(0.004)^{1/2}$$

	CHANNEL			OVERBANK				
STAGE	A (ft²)	P (ft)	Q (cfs)	A (ft²)	P (ft)	Q (cfs)	2 Q	TOTAL FLOW (cfs)
3	67.5	27.8	286	-	-	0	0	286
5	117.5	27.8	717	20	20.1	31	62	779
7	167.5	27.8	1291	80	40.2	198	396	1687
9	217.5	27.8	1992	180	60.3	582	1164	3156
10	242.5	27.8	2386	245	70.4	876	1753	4139
12	292.5	27.8	3257	405	90.5	1710	3420	6677
14	342.5	27.8	4233	605	110.5	2919	5837	10,070

K·E 10 X 10 TO ½ INCH 7 X 10 INCHES
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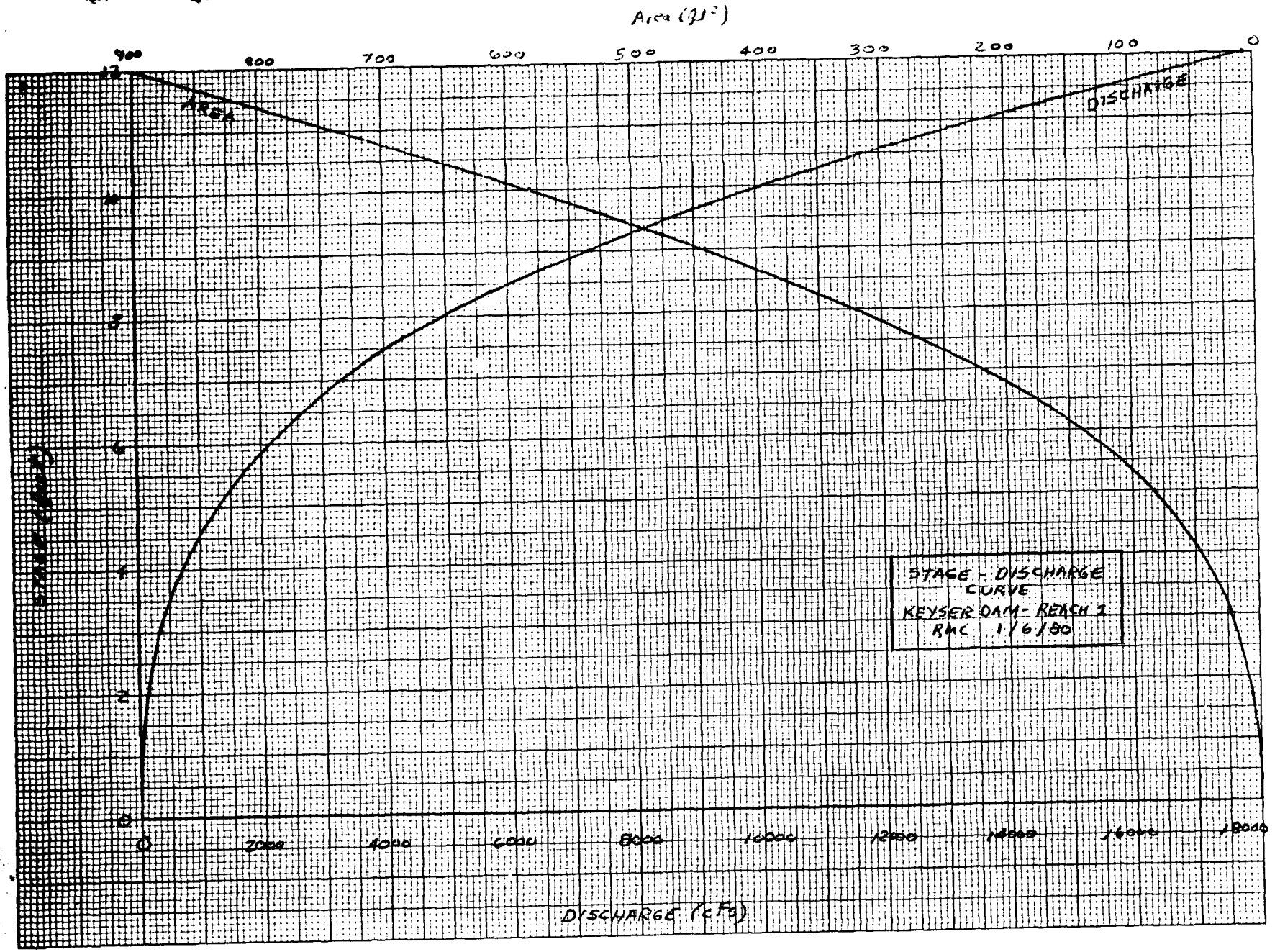


Job No. 7115 Sheet 18 of 26
Project Keyser Dam Date 12/13/79
Subject HYDRAULICS / HYDROLOGY By RMC Ch'k. by

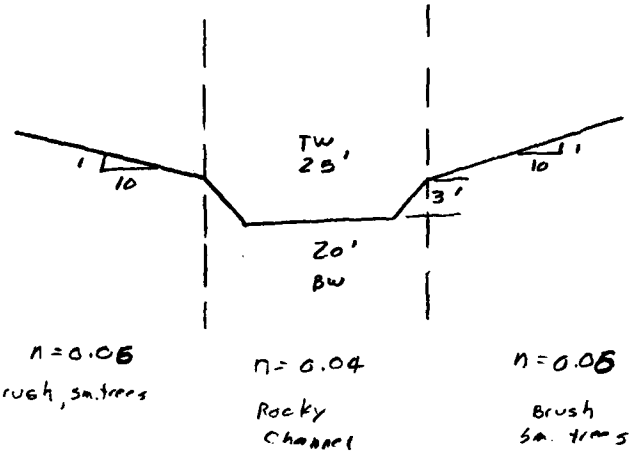
REACH 2

XS DATA APPROXIMATED FROM USGS MAPPING

$L = 13{,}500'$

$\Delta elev = 660 - 600 = 60$

$S = \frac{60}{13500} = 0.004$



MANNINGS EQUATION: $Q = \frac{1.49}{n} A R^{2/3} S^{1/2}$ $\quad R = A/P$

REACH 2

Sample calculation

Stage = 3' $\quad Q_{CHANNEL} = \frac{1.49}{0.04}(22.5)\left(\frac{22.5}{12.8}\right)^{2/3}(0.078)^{1/2} = 340 cfs$

STAGE	CHANNEL A (ft^2)	CHANNEL P(ft)	Q_{CH} (cfs)	OVERBANK A(ft^2)	OVERBANK P(ft)	Q_{OB} (cfs)	$2Q_{OB}$ (cfs)	TOTAL FLOW (cfs)
3'	22.5	12.8	340	–	–	–	–	340
5'	42.5	12.8	976	20	20.1	179	359	1335
7'	62.5	12.8	1852	80	40.2	749	1498	3350
9	82.5	12.8	2936	180	60.3	2203	4405	7341
10	92.5	12.8	3550	245	70.4	3317	6634	10,184
12	112.5	12.8	4913	405	90.5	6473	12946	17,860
14	132.5	12.8	6446	605	110.5	11043	22087	28,533

Job No. 91115 Sheet 17 of 26
Project Keyser Dam Date 12/13/79
Subject HYDRAULICS / HYDROLOGY By RNC Ch'k. by

STEP 2 Peak failure outflow

Q_{p_1} = (from previous page's calculations) = 12,542 cfs

STEP 3 STAGE- DISCHARGE ROUTING CURVE

NEAREST VILLAGE IS NORTH TUNBRIDGE (≈ 3.5 miles DS) PEAK FLOOD OUTPUT WILL BE ROUTED DOWN BICKNELL BROOK TO THE FIRST BRANCH, WHITE RIVER (≈ 5000'). THEN IT WILL BE ROUTED DOWN THE WHITE RIVER TO NORTH TUNBRIDGE (≈ 13500') (REACH 2)

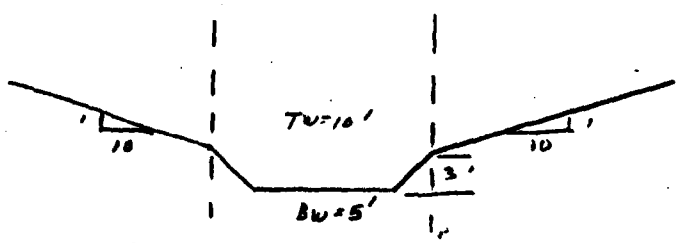
REACH 1

Approximated XS FROM Dubois and King survey data

$L = 5000'$

$\Delta elev = 1050 - 660 = 390'$

$S = \frac{390}{5000} = 0.078$



Job No. 9115 Sheet 16 of 26
Project Keyser Dam Date 4/14/86
Subject Hydraulics / Hydrology By RMS Ch'k. by

DOWNSTREAM DAMAGE ESTIMATE

Corps of Engineers recommends this procedure - Do breach analysis with water to top of dam (full spillway capacity being used). Check to see if one or more homes will be affected. If so, use this case. If not, try analysis with water to top of spillway (negligible downstream discharge) Using this order of analysis, a case will be found which will cause damage and/or loss of life (objective of analysis)

Note: Since the dam breach flow is dependant upon the physical dimensions of the dam (height and length), the dimensions of the dam are used rather than the dike dimensions (same damage area downstream) because they are larger [length - 225' vs 200'; height - 44' vs 24']

Case 1. water to top of dam (el. 107.9')

$Q_{P_1} = \frac{8}{27} W_b \sqrt{g} Y_o^{3/2} = \frac{8}{27} (0.3)\, 225 (\sqrt{32}) (21.9)^{3/2} =$

W_b = breach width = 30% Q_{P_1} = 11,595 cfs say 11,600 cfs

Y_o = height of water upstream of dam

Y_o = 107.9 - 86 = 21.9'

initial downstream discharge = 992 cfs, stage = 4.5'

TOTAL FLOW after breach = 11,600 + 992 = 12,542 cfs, stage = 10.7'

FLOOD WAVE = Δ stage = 10.7 - 4.5 = 6.2'

A 6.2' flood wave has the potential to cause concidenable damage and/or loss of life to the downstream area, hence Case 2 need not be considered.

STEP 1 Reservoir storage

@ el 107.9' = 88.2 a-f

Job No. 91115 Sheet 15 of 26
Project Keyser Dam Date 4/14/80
Subject Hydraulics / Hydrology By RMC Ch'k. by

CONCLUSIONS

1) Reservoir storage will reduce the PMF test inflow of 2150cfs to an outflow of 2076 cfs (3% reduction). The ½ PMF test flood of 1075 cfs will be reduced to an outflow of 1010cfs (6% reduction).

2) The spillways can only pass 942cfs before the dam is overtopped. This is 45% of the full PMF discharge and 93% of the ½ PMF discharge.

3) The dam would be overtopped by 0.8 feet by the full PMF (el 108.7) ½ PMF would overtop the dam by 0.1' (el. 108.0')

DuBois & King, Inc. ENGINEERING AND ENVIRONMENTAL SERVICES RANDOLPH VERMONT 05060

Job No. 1115 Sheet 14 of 26
Project
Date 4/14/80
Subject
By Ch'k. by

Q_{p1} = 1075 cfs surcharge elevation, 108.05'

$STOR_1$ = 90 - 63.6 = 26.4 a-f

$STOR_1 = \frac{26.4 \times 12}{540} = 0.5867''$

$Q_{p2} = Q_{p1}(1 - \frac{0.5867}{7.5}) = 1009$ cfs

surcharge elevation$_2$ = 107.95'

$STOR_2$ = 87 - 63.6 = 25.4 a-f

$STOR_2 = \frac{25.4 \times 12}{540} = 0.5644''$

$STOR_{ave} = (0.5644 + 0.5867)/2 = 0.5756''$

$Q_{p3} = 1075(1 - \frac{0.5756}{9.5}) = 1010$ cfs

surcharge elevation$_3$ = 107.95' ≈ 108.0'

[illegible] elevation$_3$ = surcharge elevation$_1$ 108.0'

[illegible] elevation [illegible] values without change

Job No. 7115 Sheet 12 of 26
Project [illegible] Date 4/14/80
Subject [illegible] By [illegible] Ch'k. by

[illegible] OF SURCHARGE STORAGE [illegible]

Q_1 = 2150 cfs surcharge elev = 108.7'

STOR$_1$ = SURCHARGE VOLUME − NORMAL POOL VOLUME = 93 − 63.6'

STOR$_1$ = 29.4 ac-ft

$$SI_1 = \frac{29.4 \text{ ac-ft} \times 12''/ft}{540 \text{ sq mi}} = 0.6533''$$

$$Q_2 = Q_P\left(1 - \frac{STOR_1}{19}\right) = 2150\left(1 - \frac{0.6533}{19''}\right) = 2076 \text{ cfs}$$

surcharge elevation$_2$ = 108.65'

STOR$_2$ = 92.5 − 63.5 = 29.0 ac-ft

$$SI_2 = \frac{29.0 \times 12}{540} = 0.6422''$$

$$SI_{ave} = (0.6422 + 0.6533)/2 = 0.6478''$$

$$Q_3 = 2150\left(1 - \frac{0.6478}{19}\right) = 2076 \text{ cfs}$$

surcharge elevation$_3$ = 108.65 say 108.7'

surcharge elevation$_3$ = surcharge elevation$_2$ = 108.7', no further iterations necessary, values will not change further.

Since the dam is overtopped, the ½ PMF storm must be routed for dynamic spillway adequacy.

K·E 10 X 10 TO ½ INCH 7 X 10 INCHES
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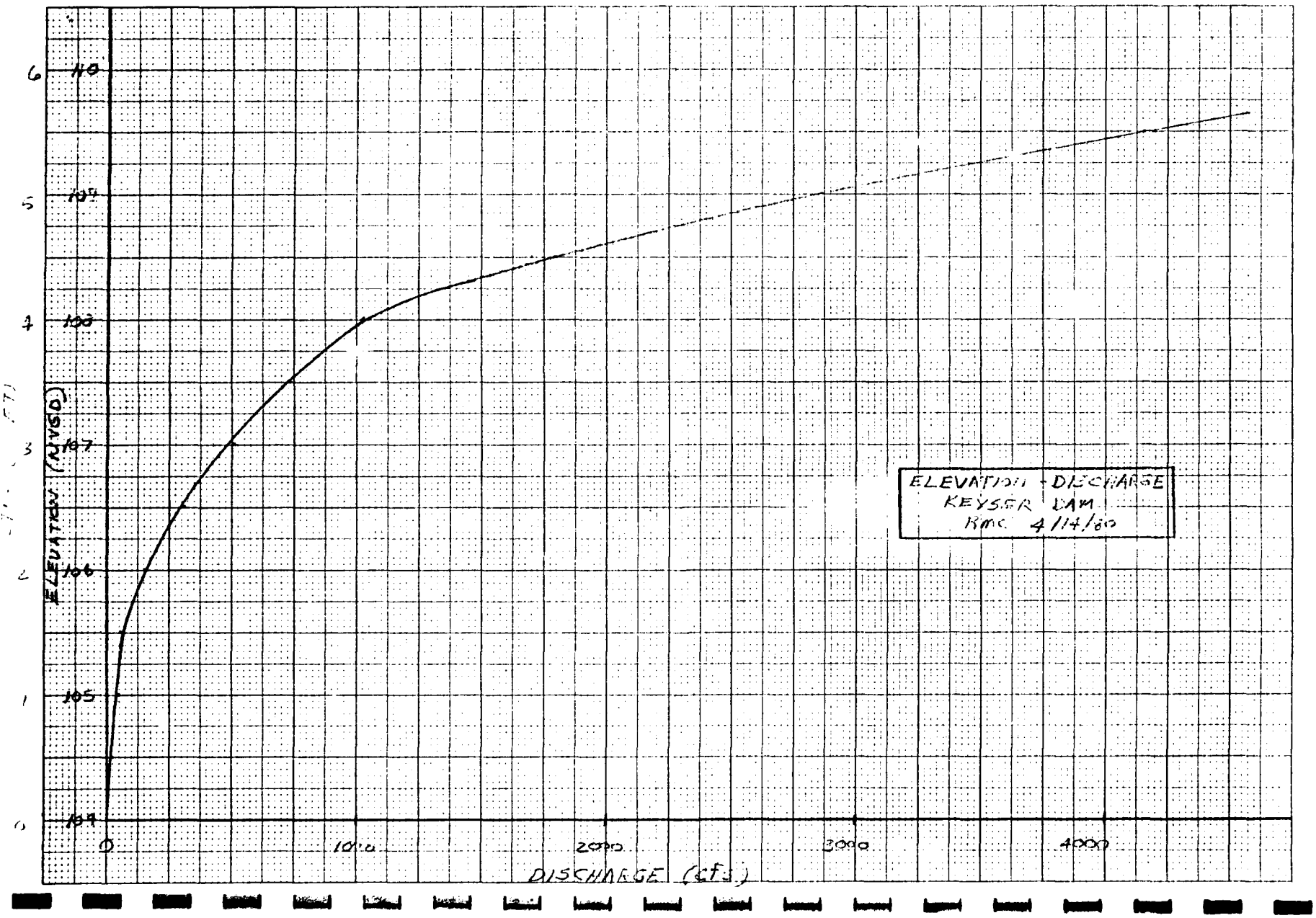

ELEVATION (ft)	PIPE HEAD (ft) (corrected)	PIPE FLOW (cfs) (corrected)	EMERGENCY SPILLWAY HEAD (ft)	EMERGENCY SPILLWAY FLOW (cfs)	WEIR CREST (ft)	WEIR FLOW (cfs)	TOTAL FLOW (cfs)
104.0	0	-	-		-		0
104.5	0.5	16.4	-		-		16
105.0	1.0	46.5	-		-		47
105.5	35.7	53.7	0.1	7	-		53
106.0	36.2	51.1	0.6	105	-		156
106.5	36.7	51.5	1.1	260	-		312
107.0	37.2	51.7	1.6	455	-		507
107.5	37.7	52.2	2.1	685	-		737
108.0	38.2	51.5	2.6	943	0.1	35	1031
108.5	31.7	52.7	3.1	1228	0.6	514	1795
107.0	37.2	53.2	3.6	1537	1.1	1275	2365
109.5	37.7	53.5	4.1	1868	1.6	2236	4153
110.0	40.2	53.7	4.6	2220	2.1	3363	5637

K&E 10 X 10 TO 1 INCH 2 X 10 INCHES
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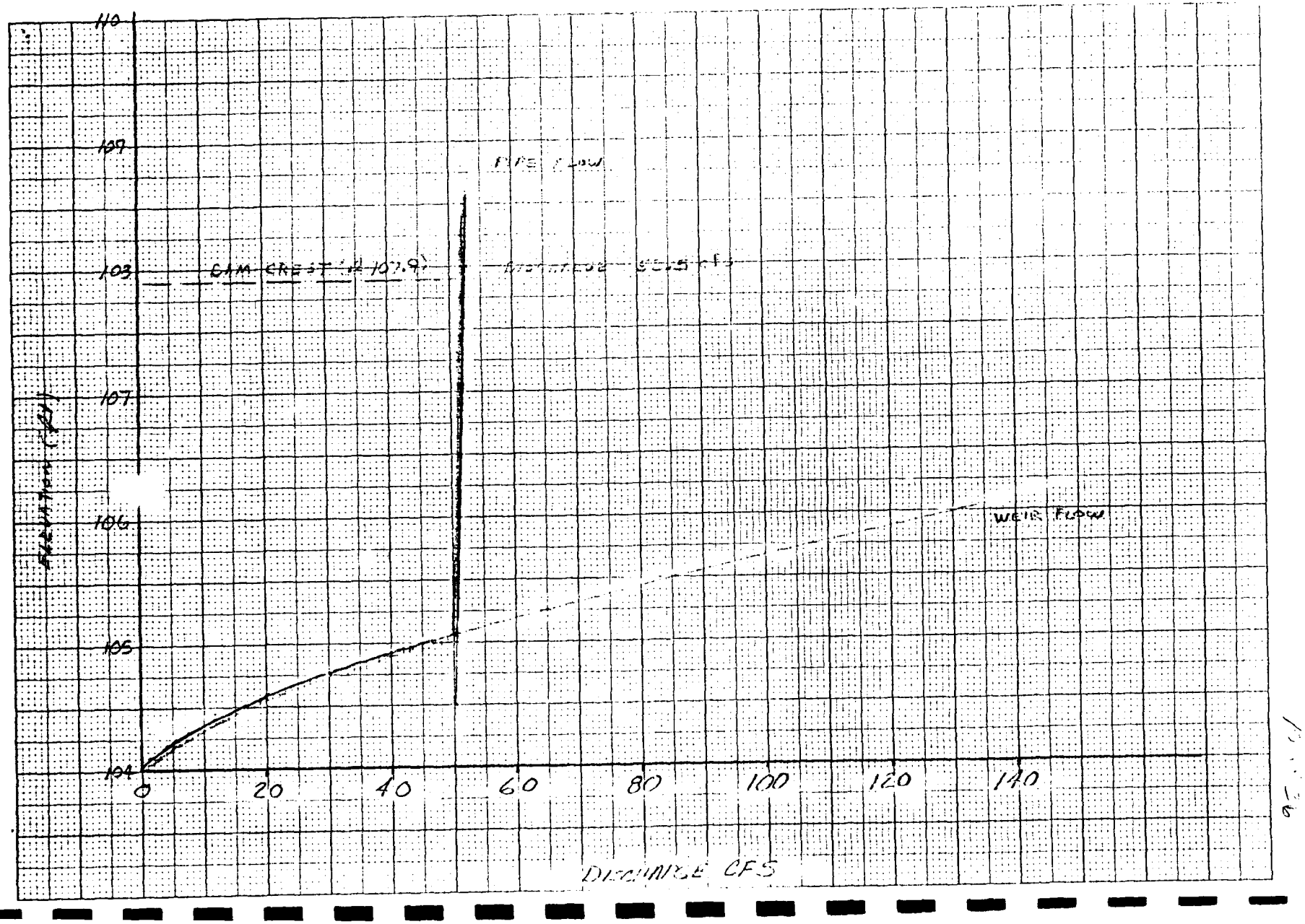


Job No. 91115 Sheet 7 of 26
Project Keyser Dam Date 1/15/90
Subject Hydraulics By RMC Ch'k. by

CALCULATIONS FOR DETERMINATION OF WHICH CONTROLS, OUTLET PIPE OR DROP INLET WEIR FLOW

$Q_{True} = 8.498\ H^{1/2}$

$Q_{weir} = 3.1\ (15)\ H^{3/2}$

$Q_{weir} = 46.5\ H^{3/2}$

	WEIR		PIPE		
Elev	H_w	Q_w	H	Q_p	$Q_{control}$
104.0	0	—	0	—	—
104.5	0.5	16.4	34.7	50.1	16.4
105.0	1.0	46.5	35.2	50.4	46.5
105.5	1.5	85.4	35.7	50.8	50.8
106.0	2.0	131.5	36.2	51.1	51.1
106.5	2.5		36.7	51.5	51.5
107.0	3.0		37.2	51.8	51.8
107.5	3.5		37.7	52.2	52.2
108.0	4.0		38.2	52.5	52.5
108.5	4.5		38.7	52.9	
109.0	5.0		39.2	53.2	
109.5			39.7	53.5	
110.0			40.2	53.9	

Job No. 91115 Sheet 8 of 26
Project Keyser Dam Date 1/4/80
Subject Hydraulics / Hydrology By RMC Ch'k. by

DEVELOP RATING CURVE FOR DAM (cont'l)

Emergency spillway (el 105.4) $Q = CLH^{3/2}$

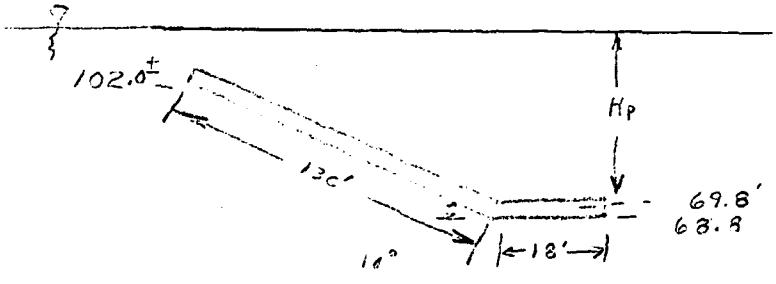
$L = 75'$

$C_w = 3.0$

$Q = 3.0\ (75)H^{3/2}$

$Q = 225\ H^{3/2}$

Primary outlet - 24" ϕ BCCMP



Ref.: Engineering Field Manual (S
(Section 3)

REF: SCS
Drawing No. ESNE - 2
July 56

$n = 0.025$

$A_p = \frac{\pi}{4}(D)^2 = \frac{\pi}{4}(2)^2$

$A_p = 3.14\ ft^2$

$g = 32.2\ ft/sec^2$

$K_m = 1.0$

$\ell = 148'$

$K_p = 0.0459$

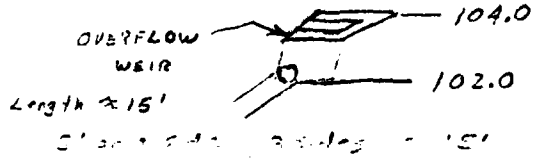
$Q = C_p H_p^{1/2}$

$C_p = A_p \sqrt{\frac{2g}{1 + K_m + K_p L}}$

$Q = 3.14 \sqrt{\frac{2(32.2)}{1 + 1.0 + 0.0459(148)}}\ H_p^{1/2}$

$Q = 8.498\ H_p^{1/2}$

NOTE: PIPE INVERT IS AT 102.0 feet ± but Inlet does not allow flow until elevation 104.0 is reached



Job No. 7111E Sheet 1 of 26
Project Kaiser Dam Date 4/14/80
Subject Hydraulic / Hydrology By JMC Ch'k. by

STEP 1

CALCULATION OF TEST FLOOD

classification - size - intermediate
hazard - high

Basin - Mountainous

Hydrologic Evaluation Guidelines Recommend

Full PMF

Enter PMF curve envelope, find that drainage area of 0.84 mi^2 is off curve. Corps of Engineers recommends using smallest DA ($2 mi^2$) and multiplying cfs/mi^2 times the actual DA ($0.84 mi^2$)

$$PMF = 2550 \frac{cfs}{mi^2} \times 0.84\ mi^2 = 2142\ cfs$$

say 2150 cfs

$$\tfrac{1}{2} PMF = 2150/2 = 1075\ cfs$$

OVERTOP RATING CURVE FOR DAM AND OUTLETS

DAM CREST ITSELF (use length along top of dam and dikes) at 107.9'

$C_w = 2.6$

$Q = CLH^{3/2}$

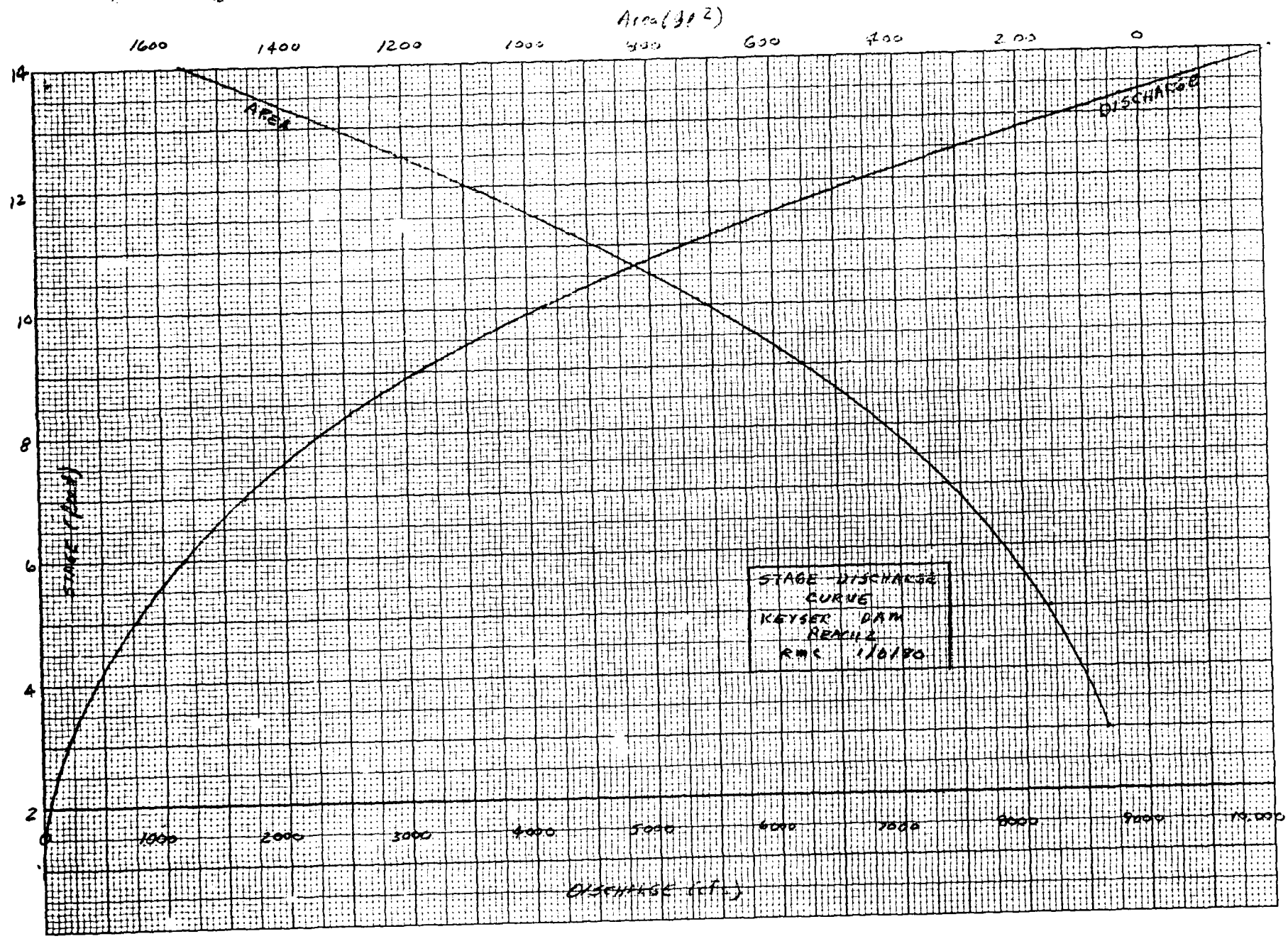
$L = 225 + 200' = 425$

$Q = 2.6(425)H^{3/2}$

$Q = 1105\ H^{3/2}$

K·E 10 X 10 TO ½ INCH 7 X 10 INCHES
KEUFFEL & ESSER CO. MADE IN U.S.A.

46 1320



Job No. 71115 Sheet 22 of 26
Project Keyser Dam Date 4/30/80
Subject Channel Routing By RMC Ch'k. by

STEP 4 Route dam breach
ENTER REACH 1

DAM BREACH FLOW = 11,600 cfs, base flow = 942 cfs

ROUTED FLOW = 11,600 + 942 = 12,542 cfs

Q_{P_1} = 12,542 cfs stage = 10.7' area = 690 □'

L_T = 5000'

$$L_1 = \frac{88.2 \text{ a-f}}{2} \times \frac{43560 \text{ □'}}{\text{acre}} \times \frac{1}{690 \text{ □'}} = 2784'$$

L_1 = 2784'

$$V_1 = \frac{2784' \times 690 \text{ □'}}{43560 \text{ □'/acre}} = 44.1 \text{ a-f}$$

$$Q_{P_{trial}} = Q_{P_1}\left(1 - \frac{V_1}{S}\right) = 12,542\left(1 - \frac{44.1}{88.2}\right) = 6271 \text{ cfs}$$

stage = 8.6' area = 580 □'

$$V_2 = \frac{2784 \times 580}{43560} = 37.1 \text{ a-f}$$

$$V_{ave} = (37.1 + 44.1)/2 = 40.6 \text{ a-f}$$

$$Q_{P_2} = 12,542\left(1 - \frac{40.6}{88.2}\right) = 6771 \text{ cfs}$$

stage = 8.8' area = 425 □'

L_2 = 2216'

ΣL = 5000'

L_2 = 5000' − 2784 = 2216'

$$V_1 = \frac{2216' \times 425 \text{ □'}}{43560} = 21.6 \text{ a-f} \quad \angle \frac{88.2}{2} \text{ a-f} \therefore \angle \text{ is C}$$

$$Q_{P_{trial}} = 6771\left(1 - \frac{21.6}{88.2}\right) = 5111 \text{ cfs}$$

stage = 8.1' area = 330 □'

Job No. 91115 Sheet 23 of 26
Project Keyser Dam Date 4/30/80
Subject Channel Routing By RMC Ch'k. by

$$V_2 = \frac{2216 \times 330}{43560} = 16.8 \text{ a-f}$$

$$V_{ave} = (16.8 + 21.6)/2 = 19.2 \text{ a-f}$$

$$Q_{P_2} = 6771 \left(1 - \frac{19.2}{88.2}\right) = 5298 \text{ cfs}$$

stage = 8.2', base flow stage = 4.5'

Flood wave = 8.2 - 4.5 = 3.7'

ENTER REACH 2

Q_1 = 5298 cfs stage = 11.0' area = 900 □'

$L_T = 13500'$

$$L_1 = \frac{88.2}{2} \text{ a-f} \times \frac{43560 \square'}{\text{acre}} \times \frac{1}{900 \square'} = 2134'$$

$L_1 = 2134'$

$$V_1 = \frac{2134' \times 900 \square'}{43560 \square'/\text{acre}} = 44.1 \text{ a-f}$$

$$Q_{P_{trial}} = 5298 \left(1 - \frac{44.1}{88.2}\right) = 2649 \text{ cfs}$$

stage = 8.5' area = 480 □'

$$V_2 = \frac{480 \square' \times 2134'}{43560} = 23.5 \text{ a-f}$$

$$V_{ave} = (23.5 + 44.1)/2 = 33.8 \text{ a-f}$$

$$Q_{P_2} = 5298 \left(1 - \frac{33.8}{88.2}\right) = 3267 \text{ cfs}$$

stage = 9.2' area = 580 □'

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Project Keiser Dam Date 4/30/80
Subject Channel Routing By RMC Ch'k. by

$L_2 = 3312'$ $\quad L_2 = \frac{88.2}{2} \times 43560 \times \frac{1}{580} = 3312'$

$\Sigma L = 5446'$ $\quad V_1 = \frac{3312 \times 580}{43560} = 44.1$ a-f

$Q_{P_{trial}} = 3267 \left(1 - \frac{44.1}{88.2}\right) = 1634$ cfs

stage = 6.9' ava = 320 □'

$V_2 = \frac{320 \times 3312}{43560} = 24.3$ a-f

$V_{ave} = (44.1 + 24.3)/2 = 34.2$

$Q_{P_2} = 3267 \left(1 - \frac{34.2}{88.2}\right) = 2000$ cfs

stage = 7.5' ava = 370 □'

$L_3 = 5192'$ $\quad L_3 = \frac{88.2}{2} \times 43560 \times \frac{1}{370} = 5192'$

$\Sigma L = 10,638'$ $\quad V_1 = \frac{5192' \times 370 \text{ □}'}{43560} = 44.1$ a-f

$Q_{P_{trial}} = 2000 \left(1 - \frac{44.1}{88.2}\right) = 1000$ cfs

stage = 5.6' ava = 210 □'

$V_2 = \frac{210 \times 5192}{43560} = 25$ a-f

$V_{ave} = (25.0 + 44.1)/2 = 34.6$ a-f

$Q_{P_2} = 2000 \left(1 - \frac{34.6}{88.2}\right) = 1216$ cfs

stage = 6.0' ava = 230 □'

Job No. 9115 Sheet 25 of 26
Project Keyser Dam Date 4/30/80
Subject Channel Routing By RMC Ch'k. by

$$L_4 = \frac{13500}{10,638} \quad 2862'$$

$$V_1 = \frac{2862' \times 580^{\square'}}{43560} = 38.1 \text{ a-f}$$

$$Q_{Petrie} = 1216\left(1 - \frac{38.1}{88.4}\right) = 692 \text{ cfs}$$

stage = 4.8' area = $175^{\square'}$

$$V_2 = \frac{175 \times 2863}{43560} = 11.5 \text{ a-f}$$

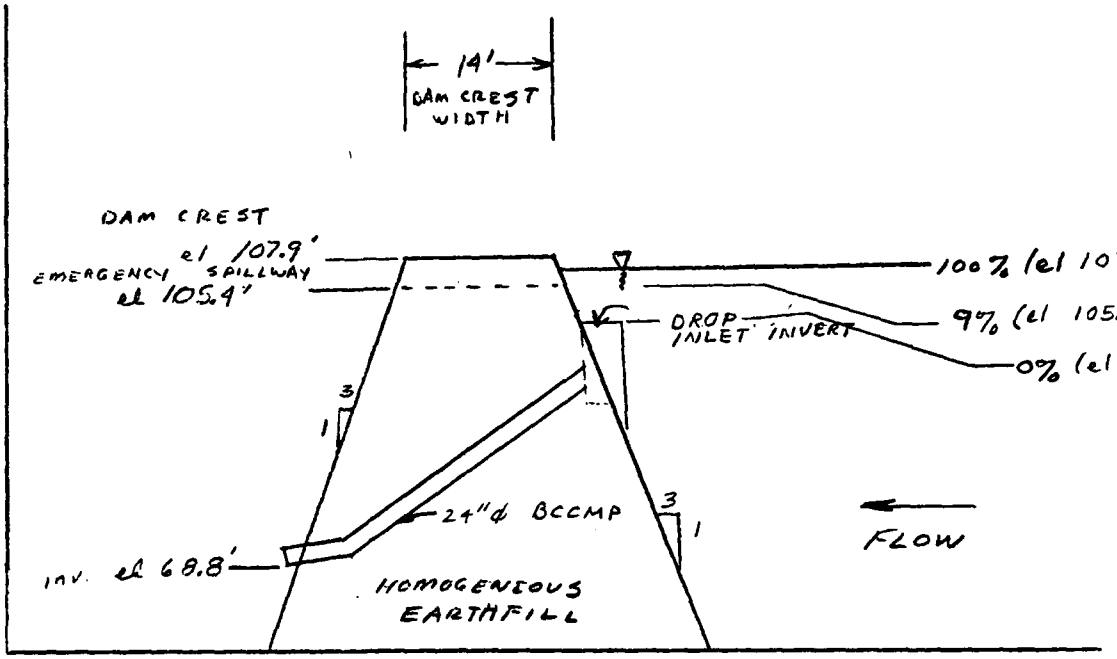
$$V_{ave} = (11.5 + 38.1)/2 = 24.8 \text{ a-f}$$

$$Q_{12} = 1216\left(1 - \frac{24.8}{88.2}\right) = 874 \text{ cfs} \quad \text{stage} = 5.3'$$

SUMMARY

REACH	DISCHARGE (cfs)	STAGE (ft)	FLOOD WAVE (ft)
AT DAM	12,542	10.7'	6.2'
5000' DS OF DAM (confluence w/ White River)	5298	11.0'	5.5'
18500' DS OF DAM (Enter North Tunbridge)	874 cfs	5.3'	Negligible

Job No. 91115 Sheet 26 of 26
Project Keyser Dam Date 1/4/80
Subject Reservoir Data By RMC Ch'k. by

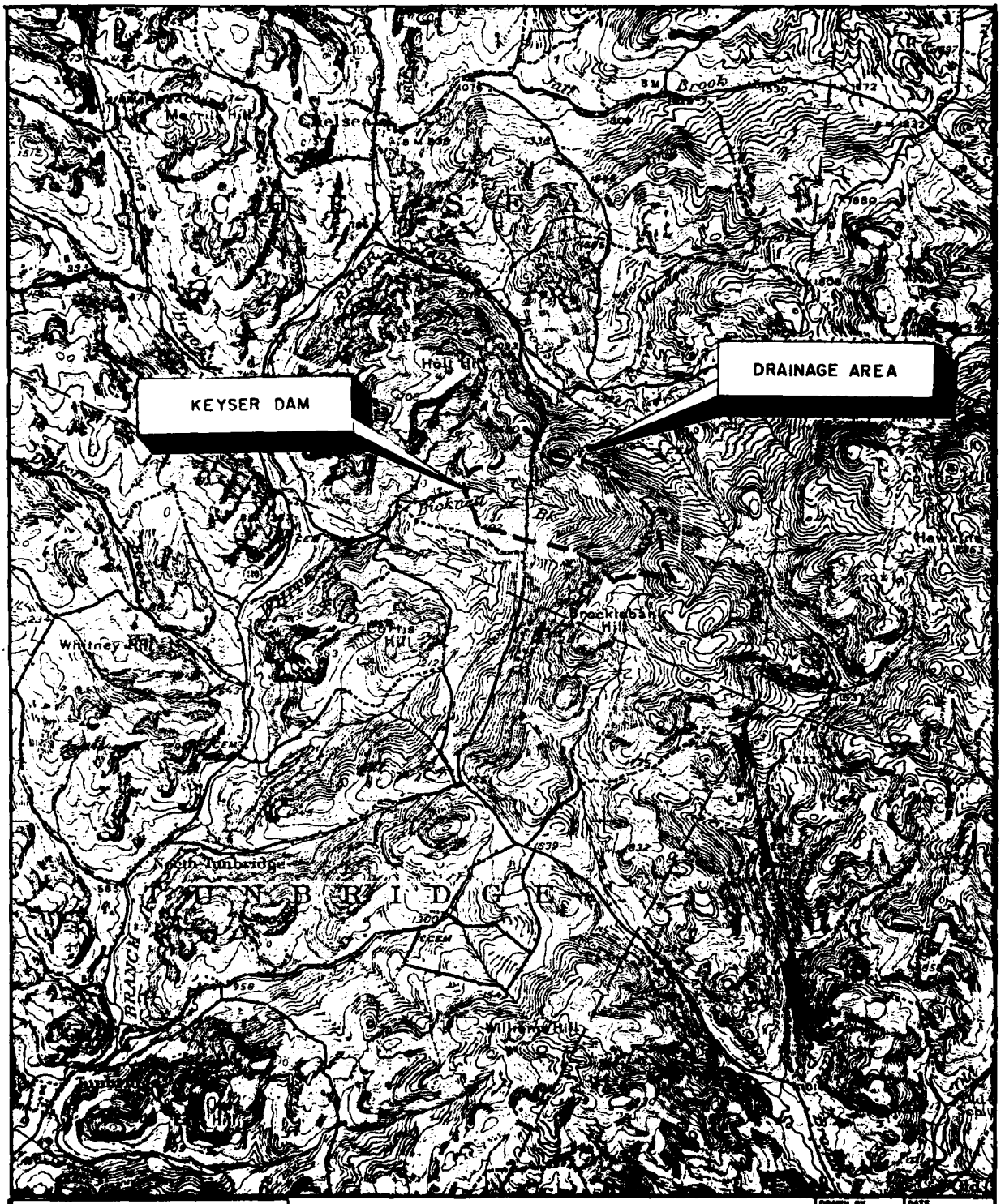


NOT TO SCALE

TEST INFLOW = 2150 cfs

SPILLWAY CAPACITY
KEYSER DAM

CONDITION AT DAM	WATER SURFACE ELEVATION	TOTAL DISCHARGE (cfs)	PRIMARY SPILLWAY CONTRIBUTION		EMERGENCY SPILLWAY CONTRIBUTION	
			DISCHARGE (cfs)	% OF TOTAL DISCHARGE	DISCHARGE (cfs)	% OF TOTAL DISCHARGE
DAM OVERTOPPED BY 0.8'	108.7'	2076	53	3%	1349	65%
WATER TO DAM CREST	107.9'	942	53	6%	889	94%
WATER TO EMERGENCY SPILLWAY CREST	105.4'	51	51	100%	–	–
WATER TO PRIMARY SPILLWAY CREST	104.0	0	–	–	–	–



DuBois & King Inc.
engineering and environmental services
RANDOLPH, VERMONT CONCORD, NEW HAMPSHIRE

NATIONAL DAM INSPECTION PROGRAM

KEYSER DAM
DRAINAGE AREA
USGS QUAD - STRAFFORD VERMONT

DRAWN BY JAS	DATE 1/80
CHECKED BY PMC	PROJ. NO. 91115
PROJ ENG	DRAW. NO.
SCALE: 1" = 62500'	

DuBois & King inc.
engineering and environmental services
RANDOLPH VERMONT · CONCORD NEW HAMPSHIRE

NATIONAL DAM INSPECTION PROGRAM

KEYSER DAM
POSSIBLE FLOOD DAMAGE AREA
USGS QUAD.- STRAFFORD VERMONT

DRAWN BY JAS	DATE 1/80
CHECKED BY RMC	PROJ. NO. 91115
PROJ ENG	DRWG. NO.
SCALE: 1"=62500	

APPENDIX E

INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS

INVENTORY OF DAMS IN THE UNITED STATES

STATE	IDENTITY NUMBER	DIVISION	STATE	COUNTY	CONGR DIST.	STATE	COUNTY	CONGR DIST.	NAME	LATITUDE (NORTH)	LONGITUDE (WEST)	REPORT DATE DAY	MO	YR
	[illegible]		VT	017	01				KEYSER DAM	4357.1	7226.1	18	JUL	80

POPULAR NAME	NAME OF IMPOUNDMENT
	KEYSER POND

REGION	BASIN	RIVER OR STREAM	NEAREST DOWNSTREAM CITY–TOWN–VILLAGE	DIST FROM DAM (MI.)	POPULATION
01	08	HICKNELL BROOK	TUNBRIDGE	1	867

TYPE OF DAM	YEAR COMPLETED	PURPOSES	STRUCTURAL HEIGHT (FT.)	HYDRAULIC HEIGHT (FT.)	IMPOUNDING CAPACITIES MAXIMUM (ACRE-FT.)	IMPOUNDING CAPACITIES NORMAL (ACRE-FT.)	DIST	OWN	FED R	PRV/FED	SCS A	VER/DATE
REPG	1965	R	90	45	88	63	NED	N	N	N	T	

REMARKS

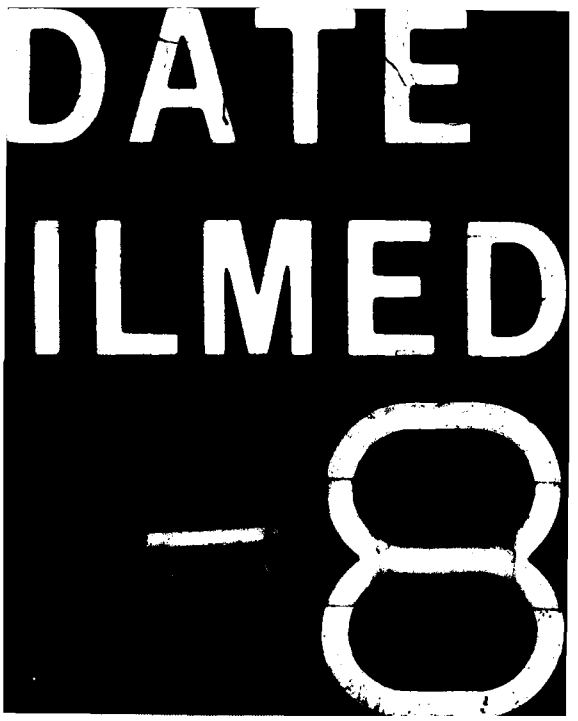
D/S HAS	SPILLWAY CREST LENGTH	SPILLWAY TYPE	SPILLWAY WIDTH (FT.)	MAXIMUM DISCHARGE (FT.)	VOLUME OF DAM (CY)	POWER CAPACITY INSTALLED (MW)	POWER CAPACITY PROPOSED (MW)	NAVIGATION LOCKS NO.	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)
1	425	U	75	952	51900											

OWNER	ENGINEERING BY	CONSTRUCTION BY
F. RAY KEYSER JR.	U.S.D.A. S.C.S.	F. RAY KEYSER JR.

REGULATORY AGENCY			
DESIGN	CONSTRUCTION	OPERATION	MAINTENANCE
VT DEPT WTR RES	VT DEPT WTR RES	VT DEPT WTR RES	VT DEPT WTR RES

INSPECTION BY	INSPECTION DATE DAY	MO	YR	AUTHORITY FOR INSPECTION
DUBOIS & KING INC.	30	OCT	79	P.L. 92-367

REMARKS
60-MAIN DAM PLUS DIKE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